SECTION 13

Critical Component Removal/ Replacement Procedures

SECTION 13
CRITICAL COMPONENT REMOVAL/REPLACEMENT PROCEDURES

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■ WARNINGS, CAUTIONS, NOTES

WARNING:

THE FOLLOWING INSTRUCTIONS ARE FOR FACTORY TRAINED SERVICE PERSONNEL ONLY; THAT IS A PERSON THAT HAS ATTENDED A 8400ST BIRD SERVICE SEMINAR CONDUCTED OR AUTHORIZED BY BIRD PRODUCTS CORPORATION SERVICE TRAINING CENTER.

CAUTION: The work must be performed in an electro static discharge (E.S.D.) controlled area. All printed circuit boards in the VIP have integrated circuits and can be severely damaged by static electricity. All P.C.B.A. must be placed in anti-static bags after removal from the VIP.

CAUTION: Unplug power cord from electrical power source, wall plug, before removing top cover.

NOTE: Each step must be followed and completed before moving to the next step.

NOTE: The component trace card must be filled out and identification label must be affixed to the rear panel. Return trace card to Bird Products Corporation, 1100 Bird Center Drive, Palm Springs, CA 92262.

After the completion of an installation, refer to Section 14, Operational Verification Procedures.

1. TOP COVER ASSEMBLY (P/N 09698)

REMOVAL	INSTALLATION
1.1 Using 9/64" Allen driver remove two Allen screws (P/N 03222) and washers (P/N 02159) from manifold base, securing the ventilator top cover to casting. Screws are inserted from under manifold bottom through casting into top cover.	At completion of operational verification procedure:
1.2 Lift the rear end of top cover (P/N 09698) with both hands about 1 1/2" upwards and slide top cover back to disengage lip from front panel housing and remove cover.	**1.1** Install top cover on manifold base, raise back of cover and slide panel forward to slip front lip under front panel housing.
	1.2 Lower cover down onto manifold base and secure using 9/64" Allen driver and two Allen screws (P/N 02159) inserted from under manifold base.

2. FRONT PANEL ASSEMBLY (P/N 15024)

REMOVAL	INSTALLATION
2.1 At Main PCB Assembly, unplug from manifold ribbon cable (P/N 15118) at J2 and (P/N 15115) at J3.	manifold base and align slots in bottom of panel brackets to align with screw holes in base.
2.2 At manometer fitting, remove tube.	**2.2** Install 4 washers (P/N 08964) and 4 Allen screws (P/N 03219) through holes and secure screws with a 7/64" Allen driver.
2.3 From manifold base, unscrew and remove four Allen screws (P/N 03219) and washers (P/N 08963) using a 7/64" Allen driver.	**2.3** Connect remaining tube #7 of tube assembly (P/N 10080) to manometer and secure with cable tie wrap (P/N 07803).
2.4 Remove front panel from manifold base.	**2.4** Plug long ribbon cable assembly (P/N 15118) from font panel assembly into Main PCB Assembly at location J2.
2.1 Position front panel brackets on top of	**2.5** Plug short ribbon cable assembly (P/N 11515) into Main PC Board assembly at J3 location.

3. PRESSURE MANOMETER (P/N 09799)/PLUG (P/N 04876) ASSEMBLY

REMOVAL	INSTALLATION
3.1 Allen screws (P/N 03219) from brackets (P/N 09639) which are holding the manometer in place.	**3.1** Remove protective bezel lens from new manometer.
3.2 Remove manometer (P/N 09799) and manometer lens (P/N 09617). (4 necessary)	**3.2** If bezel lens (P/N 20048) was removed, proceed as follows:
3.3 Remove plug (P/N 04876) from lens and discard.	**3.3** Ensure that the surface around bezel hole opening of the front panel rear surface is clean.
3.4 Clean R.T.V. sealant material from surface on inside of panel around hole opening (only if lens is replaced).	**3.4** Place R.T.V. sealing material on the inside of the front panel around the hole opening.
	3.5 Install clean bezel lens flange (P/N 20048) against the inside of rear panel with calibration hole in the three o'clock position. Remove excess sealing material.
	3.6 Install, position new manometer against lens, using two brackets (P/N 09639), with long leg of bracket retaining manometer lip. Secure manometer in place with two Allen screws (P/N 03219) using a 7/64" Allen driver.
	NOTE: Confirm that calibration hole in bezellens is aligned with manometer calibration screw position (three o'clock) before securing manometer.
	3.8 Install plug (P/N 04876) in calibration hole.

4. DISPLAY PC BOARD ASSEMBLY (P/N 50000)

REMOVAL

4.1 To remove Display PC Board Assembly from front panel, pull all control knobs (P/N 20238) off from potentiometer shafts.

4.2 From Mode selector switch located at left hand side of top row controls, remove nut and washer using a 5/16" nut driver.

4.3 With a $^{5}/_{16}$" nut driver remove all 13 Jam Nuts (P/N 03281) and locknuts (P/N 03282) from potentiometer shafts.

4.4 Remove Display PC Board Assembly from inside of rear panel housing by removing four Allen screws (P/N 03219) with a $^{7}/_{64}$" Allen driver.

4.5 Disconnect and remove Ribbon Cable Assembly (P/N 15118) (long cable) form J2 and Ribbon Cable Assembly (P/N 15115) (short cable) from J3.

4.6 Place Display PC Board Assembly in anti-static bag.

INSTALLATION

4.1 Carefully remove Display PC Board Assembly from anti-static bag.

4.2 Prior to installing Display PC Board Assembly to front panel housing, a resistance check of the potentiometers must be performed first.

4.3 Plug cable assembly (P/N 15118) (long cable) into J2 and plug cable assembly (P/N 15115) (short cable) into J3 on Display PC Board.

4.4 Connect Ohmmeter at locations on Display PC Board as shown in. Reading must be 650 OHMS.

4.5 Readjust if necessary by turning trimpot at R40 location.

4.6 Ensure that cables are correctly connected to J2 and J3.

4.7 If Ohm reading is still not correct, replace Display PC Board before continuing with the next step.

4.8 Attach Display PC Board Assembly to rear of front panel housing.

NOTE: Make certain that there are no nuts on pots before installation. Align and insert potentiometer shafts through holes in front panel. Facing rear side of Display PC Board Assembly panel, install four Allen screws (P/N 03219) using a $^{3}/_{32}$" Allen wrench.

4. DISPLAY PC BOARD ASSEMBLY (P/N 50000) *(Continued)*	
REMOVAL	**INSTALLATION**
	4.9 Install all fourteen (14) Jam nuts (P/N 03281) on the mode control and potentiometer shafts. Tighten Jam nuts with 5/16" nut driver, or torque 40 inch ounce equally. **4.10** Install friction nuts on all thirteen (13) potentiometers. (Not the mode select switch). **4.11** Tighten the friction nuts until potentiometers have the same firm friction feel.
5. MAIN PC BOARD ASSEMBLY (P/N 50010)	
REMOVAL	**INSTALLATION**
5.1 Using a 7/64" Allen driver, remove two Allen screws (P/N 03219) from upper left and right side of Main PC board. **5.2** Lift board upwards and carefully unplug from board the following cables at the following locations. **5.3** Ribbon Cable (P/N 15022) Flow transducer from J17. **5.4** Ribbon Cable (P/N 08938) circuit/ machine transducer's PC board from J4. **5.5** Ribbon Cable (P/N 15025) Exhalation Valve from J16. **5.6** Unplug alarm loudness cable wires from JP17.	**5.1** Carefully remove Main PCB Assembly from anti-static bag. **5.2** Position Main PC Board Assembly with components towards center of unit. **5.3** Connect cables as outlined before securing board in place. **5.4** Ribbon cable (P/N 71501) from Power Supply PC Board Assembly to J1 at Main PC Board Assembly. **5.5** Cable (P/N 03512) 8 pin connector from Power Supply PC Board Assembly to J14 on Main PC Board Assembly. **5.6** Ribbon cable (P/N 08938) from Transducer PC Board Assembly to J4 on Main PC Board Assembly.

5. MAIN PC BOARD ASSEMBLY (P/N 50010) *(Continued)*

REMOVAL	INSTALLATION
5.7 Unplug Fiber Optic Cable (P/N 09793) from J15.	**5.7** Install Fiber Optic Cable (P/N 15045) from rear panel to Socket J15 on Main PC Board Assembly.
5.8 Unplug 8 Pin Cable Assembly (P/N 09793) from J14.	**5.8** Ribbon cable (P/N 15025) from Power Supply PC Board to J16 on Main PC Board Assembly.
5.9 Ribbon Cable (P/N 71501) main signal from J1.	**5.9** Ribbon cable (P/N 15022) from Flow/ Volume Transducer Connector to J17 on Main PC Board Assembly.
5.10 Carefully remove Main PC board assembly and place in anti-static bag.	**5.10** Connect the volume control alarm wires from rear panel to JP17 on Main PC Board Assembly.
	5.11 Place Main PC Board Assembly in grooved slots in manifold base and attach to brackets. Install two Allen screws (P/N 03219) and secure with $^{7}/_{64}$" Allen driver.

6. FLOW TRANSDUCER PC BOARD AND MANIFOLD ASSEMBLY (P/N 50030)

REMOVAL	INSTALLATION
6.1 By hand, remove the two sensing tubes from the back of the flow sensor receptacle PC board assembly (P/N 50060).	**6.1** Carefully remove Flow/volume Transducer PCB from anti-static bag.
6.2 Unplug the ribbon cable (P/N 15022) from flow transducer PCB (P/N 50030). Unplug solenoid connector at J12 on power supply PC board.	**NOTE:** If manifold and solenoids were removed, reinstall manifold/solenoids onto transducer board at this time, using the two $^{7}/_{64}$" Allen screws.
6.3 Using $^{9}/_{64}$" Allen driver loosen only the two front screws (P/N 08833) securing the transformer and transducer bracket.	**6.2** Reconnect the 4 pin solenoid plug at J12 on the Power Supply PC board

6. FLOW TRANSDUCER PC BOARD AND MANIFOLD ASSEMBLY (P/N 50030) *(Continued)*

REMOVAL	INSTALLATION
6.4 Slide the flow transducer out and remove gas supply tubing marked (5) from the side of flow transducer manifold.	**6.3** Connect supply tubing #5 to second fitting from top of flow transducer manifold. From power transformer, loosen the two screws facing the Display PCB assembly. Slide the flow transducer mounting bracket under the two screws heads and use a 9/64" Allen wrench to secure.
NOTE: Flow manifold with solenoids may be removed from flow transducer PC board, by removing two 7/64" Allen screws from back of mounting brackets.	**6.4** Reconnect the short end of ribbon cable (P/N 15022) from the intermediate plug connection to J17 on the Flow Volume Transducer PC board.
6.5 Carefully place transducer PCB assembly in anti-static bag.	**6.5** Reconnect the intermediate plug to J17 on the Flow Sensor connector PC board (P/N 50060).

7. FLOW RECEPTACLE PCB ASSEMBLY (P/N 50060)

REMOVAL	INSTALLATION
7.1 By hand, remove the 2 sensing tubes from the back of the flow sensor receptacle PC Board assembly. Before removing tubes mark the upper tube with TOP.	**7.1** Install flow sensor connector and PC board (P/N 50060) assembly into lower front of casting as shown and secure with four 3/32" Allen screws (P/N 03226).
7.2 Remove flow sensor receptacle and PC Board (P/N 50060) assembly from right lower front of casing by removing four 3/32" Allen screws. Unplug ribbon cable (P/N 15022) and place assembly in anti-static bag.	**7.2** Install new O-ring/gaskets (P/N 20192) inner/and outer (P/N 20191).

8. POWER TRANSFORMER ASSEMBLY (P/N 08939)

REMOVAL	INSTALLATION
8.1 Remove primary wire terminals from Power Entry Module (P/N 08941) located at right side, inside of rear panel.	**8.1** With multicolored primary wires facing rear panel, position transformer into mounting pad on accumulator manifold.
8.2 Remove green/yellow ground wire terminal (P/N 08432) from ground lug located below power entry module at inside of rear panel after removing nut (P/N 01066) with a 7/16" deep socket.	**8.2** Install, but do not secure at this time, secure 9/64" Allen screws (P/N 08833).
8.3 Unplug secondary output wire socket from J9 at Power PC Board Assembly (P/N 50020).	**8.3** Connect primary wire terminals from transformer to power entry module as follows:
8.4 With a 9/64" Allen driver, remove four Allen screws (P/N 08833) securing transformer base onto mounting pad on main accumulator.	Gray from transformer to F on power entry module
8.5 Slide flow transducer mounting bracket towards front panel and remove power transformer.	Yellow from transformer to E on power entry module
	Violet from transformer to D on power entry module
	Orange from transformer to A on power entry module
	Red from transformer to C on power entry module
	8.4 Install transformer green/yellow ground wire to the ground lug stud at inside of rear panel located below the power entry module. Install nut (P/N 01066) and secure with 7/16" deep socket.
	NOTE: Make certain that ground wires do not touch transformer surfaces.

8. POWER TRANSFORMER ASSEMBLY (P/N 08939) *(Continued)*

■ CONDUCTIVITY TEST:

- With transformer installed and wire properly connected, connect Ohmmeter from ground to screwhead holding 5 Volt IC regulator Generic 323, (Bird P/N 03752).
- Ohmmeter should read low resistance.

If problem exists:

- Recheck green yellow ground wire connections on rear panel and other end at middle pin of three pin connector.
- Check continuity of wire.
- Plug 3 pin connector into J9 at Power PC Board Assembly.
- Perform Hi pot test, ref. Section 12, pg. 29-10.
- If all is correct insert plugs into the IC covers (P/N 09674).

9. POWER SUPPLY PC BOARD ASSEMBLY (P/N 50020)

REMOVAL

9.1 Facing rear of casting finned area, remove all eight plugs (P/N 09764) screws (P/N 03232), washers and four plastic covers from all regulators.

9.2 With a thin long needle nose pliers, carefully remove all four regulators and insulator gaskets. Discard gaskets.

NOTE: Look at finned area rear of casting, it appears there are five regulators. However, the center Regulator Cover (P/N 09764) is a blank. (DO NOT REMOVE). Identify each IC regulator with a BIRD P/N#.

9.3 Remove four screws (P/N 03221) with a 7/64" Allen driver from upper left and right hand side of finned area.

ASSEMBLY

9.1 Carefully remove Power Supply PC Board Assembly from anti-static bag and lower board down into place at back of manifold casting.

9.2 Position two insulators (P/N 20097) onto inside rear of heat sink. Insulators are placed into recessed regions while registering with holes in heat sink. Press into place firmly.

9.3 Install four screws (P/N 03221) through rear of heat sink into metal blocks on Power Supply PC board and tighten.

9.4 Before securing panel, connect cable assembly (P/N 03515) from Bridge Rectifier to J5 on the Power Supply PC Board and the 6 pin connector of cable assembly (P/N 03513) from rear panel to J8 on Power Supply PC Board.

9. POWER SUPPLY PC BOARD ASSEMBLY (P/N 50020) *(Continued)*

REMOVAL

9.4 Facing inside rear of ventilator, unplug from Power Supply PC Board the following cable connections:

a) Safety Solenoid (P/N 08940) at J10.

b) Flow Control Valve Assembly (P/N 09740) at J7.

c) Exhalation Valve Cable at J6.

d) Cable J12.

9.5 With 7/64" Allen driver, remove the five Allen screws (P/N 03219) holding Power Supply PC Board assembly to rear panel.

9.6 With a 7/64" Allen driver, loosen only the four Allen screws (P/N 03219) and washers (P/N 04383) securing rear panel to manifold base.

ASSEMBLY

9.5 Align IC regulator sockets with socket holes in rear of manifold casting (finned area). Hole Power Supply PC Board panel in place while installing and securing five screws (P/N 03219) with a 7/64" Allen wrench.

9.6 At this time secure the four screws (P/N 03219) and washers (P/N 04383) of the rear panel using a 7/64" Allen Driver.

9.7 Connect Safety Solenoid assembly (P/N 08940) connector to Power Supply PC Board at J10.

9.8 Facing rear of casting with long needle nose plier, carefully install the Mosfet IC (P/N 68001) onto 1st position of heat sink (left hand rear of casting). Use insulator (P/N 09672) between IC and casting.

NOTE: Refer to IC regulator insulation test before installing the next IC regulator. Check each regulator after installation.

9.9 Install one Regulator (P/N 03752) into 2nd position of casting heat sink. Use Insulator (P/N 09672) between device and manifold. Place cover (P/N 09674) over device and attach using two screws (P/N 03233) and two washers (P/N 09674), which are provided with cover (P/N 09674).

9.10 Install two Regulator IC's (P/N 03584) into 4th and 5th position of rear of

9. POWER SUPPLY PC BOARD ASSEMBLY (P/N 50020) *(Continued)*

REMOVAL	ASSEMBLY
	casting heat sink. Use Insulator (P/N 09672) between device and casting, place cover (P/N 09674) over device and attach using two screws (P/N 03233) and two washers which are provided with cover (P/N 09674).
	NOTE: 3rd position is empty. Perform insulation test as below, after each IC installation.

■ IC REGULATORS INSULATION TEST:

❒ **Installation:**

- After installing each IC regulator, check circuit for proper insulation. With Ohmmeter, check to insure that circuit reads open from screwhead securing IC regulator to ground lug on rear panel below power entry module.
- If Ohmmeter reads low resistance or short implement troubleshooting guide, before continuing with next step, power transformer (P/N 09756) installation.

❒ **IC Regulator Troubleshooting Check:**

- Ohmmeter reads CLOSED instead of OPEN.
- Cut in insulator (P/N 09672).
- Misalignment of IC regulator socket into casting.
- IC regulator not properly installed.

NOTE: If all checks correctly go to next step.

- Set Main Power Switch to ON position.
- On the transformer 3 pin connector, measure two outer pins of the 3 pin connector of transformer, voltmeter should read 12-15 Volt AC. If not, check wiring to power entry module. If wiring is correct replace transformer. If transformer test outcome is good, plug 3 pin connector to J9 at Power Supply PC Board.
- Connect voltmeter to 8 pin socket of Power harness (P/N 03512) as follows and confirm the proper voltage outputs.

■ IC REGULATORS INSULATION TEST *(Continued)* :

- Connect negative (-) from voltmeter to black lead on power harness.
- Positive lead (+) TO YELLOW= 14.7 to 20 VDC:
- Positive lead (+) TO RED= 5 VDC

☐ **14.7 - 20 Volt DC Fault Check:**

- Double check all connections of J5, J8, J9.
- Check fuse in power entry module and fuse F1 on Power Supply PC Board.
- Check that AC/ALT Power Switch is on the AC LINE position.

☐ **5 Volt DC Fault Check:**

- Check 5 Volt IC regulator socket for oversize connector.
- Replace 5 Volt IC regulator.
- Replace Power Supply PC Board.
- Switch Main Power Switch OFF and remove power cord from ventilator and AC power supply source.
- Insert exhalation valve cable connector into J6 and flow control valve cable connector into J7 on Power Supply PC Board.

10. REAR PANEL ASSEMBLY (P/N 10131)

REMOVAL	INSTALLATION
10.1 With screwdriver, loosen hose clamp (P/N 09787) at inlet elbow fitting (P/N 32110) located at left hand top side of accumulator and push hose clamp back.	**10.1** Check condition of moisture seal strip (P/N 08882) on top of panel, replace if necessary.
10.2 With 7/64" Allen driver, remove the five Allen screws (P/N 03219) holding Power Supply PC Board assembly to rear panel.	**10.2** With all components on panel in place, position and align rear panel assembly down on top manifold assembly.
10.3 Lift rear panel upwards, pry and remove hose from elbow fitting (P/N 32110) and remove rear panel.	**10.3** Install, but do not secure at this time, four screws (P/N 03219) and washers (P/N 03219) and washers (P/N 04383) using a 7/64" Allen screwdriver and hold rear panel in place.

10. REAR PANEL ASSEMBLY (P/N 10131) *(Continued)*

REMOVAL	INSTALLATION
10.4 From Inlet Filter Assembly (P/N 09762) unscrew and remove glass bowl, filter element and O-ring. Discard element and O-ring.	**10.4** With 7/64" Allen driver install and secure five (5) Allen screws (P/N 03219) securing Power Supply PC Board to rear panel. **10.5** Secure the four (4) screws with washers securing rear panel assembly to casting.

11. FLOW CONTROL VALVE ASSEMBLY (P/N 09740)

REMOVAL	INSTALLATION
11.1 Remove flow control valves cable connector from J7 socket on Power Supply PC board assembly.	**11.1** Install two O-rings (P/N 03374) into counter bores of flow control valve body.
11.2 Using a 9/64" Allen driver, remove two Allen screws (P/N 03218) securing the valve assembly on manifold mounting pad and lift assembly out of unit.	**11.2** Position and align holes of flow control valve gasket (P/N 08880) with holes in flow control valve body mounting pad on manifold base.
11.3 Remove and discard two O-rings (P/N 03374) from counterbore holes in base of valve body.	**11.3** Using a 9/64" Allen screw driver, secure the two Allen screws (P/N 03218).
11.4 Remove and discard Valve Gasket (P/N 08880) located on mounting pad. Place valve in anti-static bag.	**NOTE:** Tighten screws evenly.
	11.5 Reconnect flow valve cable to J7 on Power PCB Assembly.

12. EXHALATION VALVE ASSEMBLY (P/N 10083)

REMOVAL

12.1 Remove ribbon cable J6 from Main PC Board assembly.

12.2 Remove exhalation valve cable connector 12 pin cable connector from Power Supply PC Board assembly at J.

12.3 Remove tubing from barbed fitting on top of exhalation valve assembly.

NOTE: When removing the exhalation valve assembly, use care when removing the screw at the lower left that retains the latch button. Behind the button is a small spring.

12.4 Using a 7/64" Allen driver, first remove the screw (P/N 03219) that retains the latch button (P/N 20040) shoulder washer (P/N 20041), and spring (P/N 31004).

12.5 Next remove the remaining three (3) screws (P/N 03219).

12.6 Remove exhalation valve assembly from the unit and place in an anti-static bag.

INSTALLATION

12.1 Position exhalation valve assembly inside front of machine (lower left as you face front of unit), with tube fitting upwards.

12.2 Secure with 7/64" Allen driver, three screws (P/N 03219) in all but the lower left corner from the front.

12.3 Into lower left corner recess of exhalation valve, place a button (P/N 20040) and spring (P/N 31004). While holding button depressed, position washer (P/N 04383) and retainer (P/N 20091) over remaining hole and secure using fourth screw (P/N 03219).

12.4 Button should now be spring loaded and actuate smoothly.

12.5 Connect tubing #2 to barbed fitting of exhalation valve assembly.

12.6 Insert exhalation valves cable connector into J6 socket on Power Supply PC Board assembly.

12.7 Insert ribbon cable (P/N 15025) into J16 socket on Main PC Board assembly.

13. PRESSURE REGULATOR (P/N 09712)

REMOVAL

13.1 Position manifold base on its fins to expose base bottom plate.

13.2 Insert 9/64" Allen driver through holes in manifold base plate, remove four Allen screws (P/N 03257) securing regulator on mounting pad and remove regulator.

NOTE: Hold regulator up with your hand to support its weight during removal of screws.

13.3 Remove and discard two O-rings (P/N 03375) from holes in regulator base.

13.4 Remove purge tube connector (P/N 04506) from safety valve silicone rubber elbow.

INSTALLATION

13.1 Install fitting included with regulator into side of regulator body using Teflon tape and secure with a 1/4" nut driver.

13.2 Position two O-rings (P/N 03375) into counterbore of holes in bottom of regulator.

13.3 Position regulator on top of manifold mounting pad positioned with fitting (or part marked IN) toward rear of manifold casting.

13.4 Secure regulator onto manifold mounting pad with four 9/64" Allen screws (P/N 03257). Tighten evenly.

NOTE: Fairchild - position regulator on top of manifold mounting pad with fitting facing towards Display PC Board Assembly. (Bleed fitting is already installed.)

13.5 Install one end of purge assembly (P/N 08934) to regulator fitting and other end elbow fitting into safety valve silicone elbow.

14. PRESSURE TRANSDUCER PC BOARD ASSEMBLY (P/N 09680)

REMOVAL	INSTALLATION
14.1 Remove ribbon cable (P/N 08936) form socket J4 on Pressure Transducer PC Board assembly.	**14.1** Install three new O-rings (P/N 03372) into counter bore parts in manifold base.
14.2 Using 7/64" Allen driver, remove four Allen screws (P/N 03220) securing board onto manifold mounting pad, then remove board.	**14.2** Place Transducer Pc Board Assembly onto manifold casting, positioning the three pressure ports from the transducer to align with the three ports and O-rings in manifold base.
14.3 Remove and discard O-rings (P/N 03372) from transducer and/or manifold mounting pad.	**14.3** Secure Transducer PC Board Assembly to manifold base with four Allen screws (P/N 03220) using a 7/64" Allen torque screwdriver.
14.4 Carefully place Pressure Transducer PCB Assembly in anti-static bag.	**NOTE:** Torque Allen screws (P/N 03220) evenly to 16 inch ounces. First run screws down to make contact with PC Board.
	14.4 Insert ribbon cable (P/N 08936) in socket J4 on Pressure Transducer PC board Assembly.

15. SAFETY VALVE SOLENOID ASSEMBLY (P/N 08940) (Old Style - Clippered Valve, 3-way)

REMOVAL	INSTALLATION
15.1 Remove front panel assembly (P/N 15024) as described.	**15.1** Lightly lubricate both O-rings using Lubricant (P/N 00042).
15.2 Unplug and remove flow transducer ribbon cable (P/N 15022) at J17 socket located on flow transducer and flow sensor PC Board assembly.	**15.2** Install Safety Solenoid by hand and secure using Solenoid wrench. Hold wires upwards while tightening to prevent tangling.
15.3 At flow sensor receptacle remove both silicone tubes, mark each tube as per their location (top/bottom).	**15.3** Position wires around dome of Pulsation Dampener Accumulator to square pad (P/N 08231) located on right front side of accumulator.

15. SAFETY VALVE SOLENOID ASSEMBLY (P/N 08940) (Old Style) *(Continued)*

REMOVAL	INSTALLATION
NOTE: Hold up wires to prevent tangling while turning.	**15.4** Insert Safety Solenoid wires connector into J10 on Power Supply PC Board assembly.
15.4 Remove flow sensor receptacle and PC Board Assembly from right lower front of casting, by removing four 3/32" Allen screws. Place assembly in anti-static bag.	**15.5** Secure wires into bracket using tiewrap cable (P/N 07803), cut off excess cable length.
15.5 Pull elbow fitting from regulator purge tube assembly (P/N 08934) out of safety valve silicone rubber elbow (P/N 09603).	**15.6** Remove flow sensor receptacle from anti-static bag. Install flow sensor receptacle assembly and secure with four 3/32" Allen screws (P/N 03226).
15.6 Cut cable tiewrap (P/N 07803) on pad (P/N 08231) located on right front side of accumulator.	**15.7** Connect both silicone tubes to the flow sensor receptacle as marked.
15.7 Unplug Safety solenoid wires connector at J10 on Power Supply PC Board Assembly.	**15.8** Insert elbow fitting from pressure regulator purge tube assembly into safety valve silicone elbow.
15.8 Insert pin of solenoid wrench (P/N 03426) in one of the three holes at base of safety solenoid valve body	**15.9** Insert flow transducer cable connectors into sockets J10 located on flow transducer and flow sensor receptacles PC Board assembly.
	15.10 Install front panel as described.

16. SAFETY VALVE SOLENOID ASSEMBLY (P/N 00940) (New Style - Pneutronics)

REMOVAL	INSTALLATION
16.1 Remove front panel assembly as described.	**16.1** Lightly lubricate both O-rings using lubricant (P/N 00042).
16.2 Unplug and remove flow transducer ribbon cable (P/N 15022) at J17 socket located on flow transducer and flow sensor PC Board assemblies.	**16.2** Install safety solenoid by hand and secure using solenoid wrench.

16. SAFETY VALVE SOLENOID ASSEMBLY (P/N 00940) (New Style) *(Continued)*

REMOVAL	INSTALLATION
16.3 At flow sensor receptacle remove both silicone tubes. Mark each tube as per their location. (top/bottom).	**16.3** Insert safety solenoid marked wire connectors on safety solenoid body terminals.
16.4 Remove flow sensor receptacle and PC board assembly from lower front of casting; by removing four $^{3}/_{32}$" Allen screws. Place assembly in anti-static bag.	**16.4** Remove flow sensor receptacle from anti-static bag. Install flow sensor receptacle assembly and secure with four $^{3}/_{32}$: Allen screws (P/N 03226).
16.5 Remove both safety solenoid wire connectors form solenoid terminals mark wires to their location (left/ right).	**16.5** Connect both silicone tubes to the flow sensor receptacle as marked.
16.6 Pull elbow fitting from regulator purge tube assembly out of safety valve silicone rubber elbow (P/N 09603).	**16.6** Insert elbow fitting from pressure regulator purge tube assembly into safety valve silicone elbow.
16.7 Insert pin of solenoid wrench (P/N 03426) in one of the three holes at the base of safety solenoid valve body, and turn counterclockwise until removed.	**16.7** Insert flow transducer cable connectors into socket J17 on flow transducer and flow sensor PC Board assemblies.
	16.8 Install front panel as described.

SECTION 14

Operational Verification Procedures & Performance Test

This section is divided as follows:

1. **EQUIPMENT REQUIRED.**
2. **PREPARATION.**
3. **CALIBRATION AND OPERATIONAL VERIFICATION PROCEDURES.**
4. **PERFORMANCE TEST.**

A numbering system is utilized so that one can easily identify the steps involved with each major operation. Complete each step in sequence outlined to obtain the required calibration parameters. If required parameters are not met, refer to the troubleshooting instructions of this manual.

NOTE: Use the Operational Verification Check Sheet (OVCS), located in the back of the Operational Verification Procedure (OVP). Follow the directions of the OVP and fill out the OVCS.

■ EQUIPMENT REQUIRED:

Stopwatch.
Standard test lung - Required compliance 20 ml/cmH_2O ± 5%. A 5 gallon rigid container filled with 22 pounds (10kg) of fine grade copper wool or equivalent.
Endotracheal tube, 7 mm, ID x 20 cm long, noncuffed with two 15 mm OD adapters.
$^3/_{32}$" Allen wrench, long shank.
$^9/_{64}$" Allen wrench, long shank.
$^{11}/_{16}$" open end wrench.
Flowtube 0 - 1.0 LPM in 0.1 LPM increments or equivalent.
Variable transformer 1 - 260 volt AC, 1 - 160volts AC depending on local voltage (Variac).
12 - 16 Volt DC power supply, 5 amps. minimum.
Trimpot Adjustment Tool.
Digital 0 - 150 cmH_2O pressure calibrated test manometer.
Air/Oxygen supply sources.
Air/Oxygen pressure regulators.
Digital Multimeter.
Anti - Static mat covering worktable and grounded to earth ground.
Anti - Static wrist strap.
Cable tie wrap tool, or it's equivalent.
Slant manometer 0 - 4 cmH_2O or it's equivalent.
8 liter volume spirometer ± 2% accuracy with temperature compensation capability, or equivalent.
P/N 00077, Inline pressure manometer, 0 - 100 PSIG.
P/N 00358, $^1/_8$" ID Tube connector.
P/N 01233, 22 mm male x 15 mm female, 2 each.
P/N 01741, 4.5 mm x $^1/_8$" tubing connector or it's equivalent.
P/N 02187, 22 mm F x 22 mm x 15 mm F tee connection, 2 each.
P/N S1020, torque seal.
P/N 03389, Pressure Transducer Test Harness.
P/N 03800, Hi/Low Flow MicroBlender.
P/N 04124, 7.5 mm plug.
P/N 08929, Alternate power source (DC) cable assembly.
P/N 09220, 0 - 15 LPM flowmeter or it's equivalent.
P/N 09520, Blender hose.
P/N 09531, 30" smooth corrugated hose and cuffs for installation between spirometer inlet and exhalation valve body check valve assembly.
P/N 10172, 8400ST Patient breathing circuit kit (autoclavable).
P/N 10233, Prox/Purge Test Housing.
P/N 10234, Flow Transducer Test Harness.
P/N 10081R, Tube assy. Flow Transducer.

■ **EQUIPMENT REQUIRED** (continued):

* P/N 10302R, Sensor, Flow Support 8400STi (Flow Support is a option. Only need sensor if you have this option on the ventilator).
P/N 20107, Exhalation Valve Diaphragm Assyembly.
P/N 20005, Exhalation Valve Body.
P/N 00066, Elbow.
P/N 04845, Test lung or equivalent.
* Test Harness Remote Alarm (remote alarm is a option.).
AC High Pot Tester.
Leakage Current Tester.

■ PREPARATION

1. Strap anti-static wrist strap around your wrist.

2. Place ventilator on top of worktable. Table must be covered with grounded anti-static mat.

3. Install Exhalation Valve Diaphragm (P/N 20107). See Test Figure 1.

4. Install Prox Purge Test Housing (P/N 10233).

5. Connect air and oxygen supply source regulator to their respective gas sources and make certain that pressure regulators are turned full counterclockwise OFF (CLOSED).

6. Open and adjust air pressure regulator and check for water contents in discharged air. If there is water present then select another air gas source.

7. Connect O_2% supply hose (P/N 00060) and air supply hose(P/N 02899) from their respective pressure regulators to their respective connections on the 3800 Hi/Low Flow MicroBlender.

8. Set O_2% concentration selection knob on 60%.

9. Attach elbow (P/N 00066) to auxiliary flow outlet of the 3800 MicroBlender. Secure using a $^{11}/_{16}$" open end wrench.

10. Install and secure a 0 - 100 inline pressure manometer (P/N 00077) to elbow (P/N 00066) and tighten wingnut.

11. Connect one end of the supply hose (P/N 09520) to inline pressure manometer (P/N 00077), and other end to ventilator inlet filter fitting. Check that inlet filter drain valve is CLOSED.

12. Open and adjust both supply source pressure regulators to 50 PSIG.

13. On ventilator rear panel, set power entry module ON/OFF switch in OFF position.

14. Insert electric power source cord into properly grounded outlet of appropriate voltage. Proceed by implementing "Operational Verification Procedure."

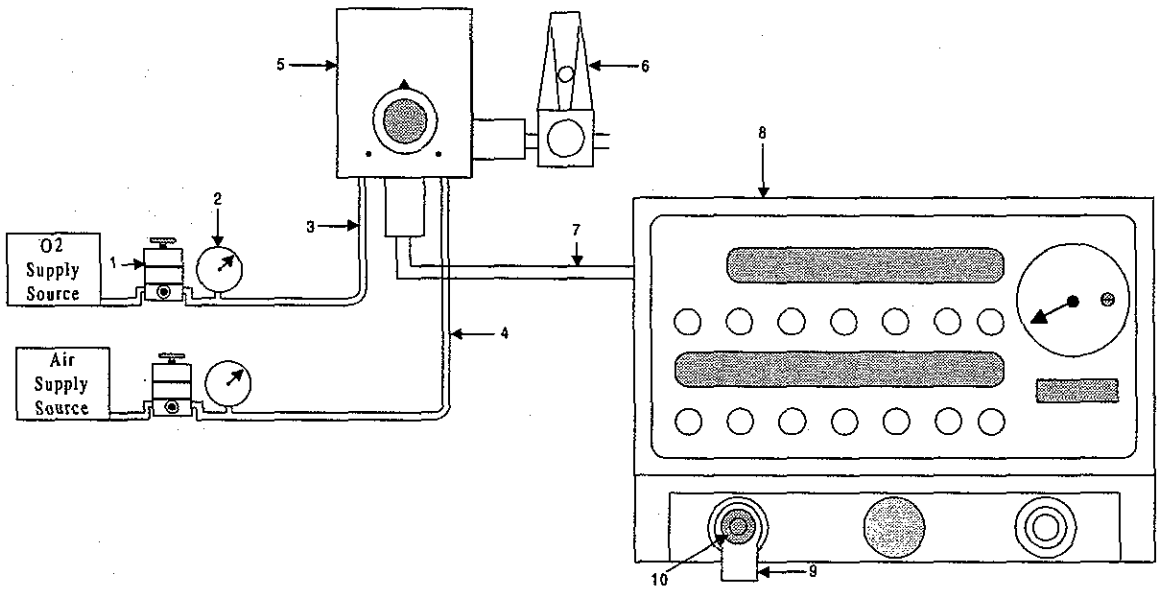
15. Adjust manometer dial to 0 cmH_2O. Check off the Operational Verification Check Sheeet (OVCS) when adjusted.

NOTE : If Purge Valve (P/N 10180) has been removed and replaced, it must be turned counterclockwise, full open to prevent excess pressure in the manometer and purge system.

* **NOTE** : If you have an EDM (Event Detection Module) then follow the directions of step 16, if not skip to **1.0 Power Up Verification**.

16. Check the Event Detection Module (EDM), before you calibrate the ventilator, for error codes. If there are any error codes refer to Troubleshooting Section 15.0 of this manual.

17. Turn the ventilator ON. Immediately after power up hold the Select and Manual Breath buttons. After a few seconds the ventilator will show a display in PEEP/CPAP, Sensitivity, and Pressure Support. Now you can release the Select and Manual Breath buttons. To scan through the EDM push the Select button. Make note of any error codes (same number in the Sensitivity and Pressure Support display). Check off the OVCS (**Section II**). When you have finished checking the EDM continue on to step **1.0 Power Up Verification**.



Test Figure 1

1. 0 - 60 PSIG Pressure Regulator (QTY2)
2. P/N 00077 0 - 100 PSIG Inline Pressure Gauge (QTY2)
3. P/N 00060 Oxygen Hose
4. P/N 02899 Air Hose
5. P/N 03800 MicroBlender
6. P/N 09220 Flowmeter
7. P/N 03867 O_2 Pressure Hose
8. 8400STi Ventilator to Test
9. P/N 20005 Exhalation Valve Body.
10. P/N20107 Exhalation Valve Diaphragm

" * " THIS MEANS THE SECTION IS AN OPTION YOU MAY HAVE WITH YOUR VENTILATOR.

1.0 POWER UP VERIFICATION

1.1 This procedure can be conducted without any electrical accessories or test equipment attached to the ventilator; however, normal gas inlet

pressure (50 PSIG) and appropriate electrical voltage must be connected to the power entry module.

1.2 Verify that Exhalation Valve Diaphragm and Prox Purge Test House (P/N 10233) are properly installed. **NO BREATHING CIRCUIT IS REQUIRED AT THIS TIME.**

1.3 Before applying electrical power to the ventilator, confirm pressure regulator to read 20.0 $\pm$ 0.5 PSI on the test manometer. If out of specification refer to Section 12, item 9.0 of the service manual. Record the result on the OVCS.

2.0 POWER UP

2.1 Depress and hold the Select button and turn ON the ventilator. Verify that the flow valve "HOMES' within 5 seconds and does not move thereafter. After flow valve has "HOMED", a series of dots will appear on the ventilator's monitor window and Backup Breath Rate (BBR) display. Check off the OVCS.

2.2 **SOFTWARE REVISION VERIFICATION :** Activate the Select button: the four-digit number, representing the Main PC Board software revision level, is displayed in the monitor window, Backup Breath Rate display (BBR) is number 1. Record the results on the OVCS.

2.3 Activate the Select button, (BBR) display is number 2. A four-digit number representing the Power Supply PC Board software revision level will appear in the monitor window. Record the results on the OVCS.

2.4 Activate the Select button, (BBR) display is number 3. A four-digit number representing the Display PC Board software revision level will appear in the monitor window. Recore the results on the OVCS.

2.5 Activate the Select button, (BBR) display is number 4. A four-digit number representing the PAL software revision level will appear in the monitor window. Record the results on the OVCS.

NOTE : The Select and Manual Breath buttons will allow for toggling the monitor window between all 4 pressure transducer readings. The pressure transducer mode is identified by the number displayed in the Backup Breath Rate (BBR) window.

MODE:
#5: THE FLOW PRESSURE
#6: THE AIRWAY PRESSURE
#7: THE MACHINE PRESSURE
#8: THE SYSTEM PRESSURE

NOTE : When in Mode #5 depressing the manual breath button will activate the purge function.

NOTE : The ventilator must run for 30 min. in **Standard Settings** with the top cover in place before performing the following test and/or adjustments.

3.0 FLOW TRANSDUCER OFF SET VERIFICATION (50030A)

NOTE : Before you do this test make sure you have no patient circuit on the ventilator or any test harnesses connected.

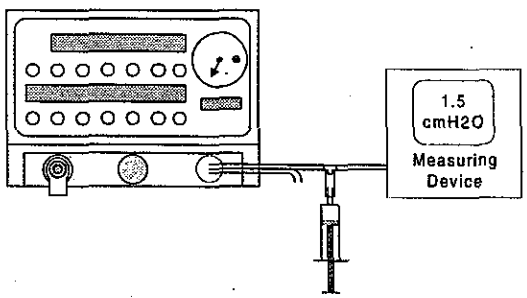
3.1 Activate the Select button, (BBR) display is the number 5. This is the Flow Transducer Off Set reading. Verify the monitor window reads 103 ± 50. If transducer is in specification then skip the next step and record the result on the OVCS.

IF THE FLOW TRANSDUCER OFF SET IS OUT OF SPECIFICATION READJUST AS FOLLOWS :

A) Adjust the R2 trim pot until the monitor window reads 103 ± 10.
B) Push the Manual Breath button to perform the Auto-Zero function. Press Select to go to #6 then Manual Breath to go back to #5 to check on the value. Readjust as needed. Record result on the OVCS.

4.0 FLOW TRANSDUCER GAIN VERIFICATION (P/N 50030A)

4.1 Connect the Flow Transducer Test Harness (P/N 10234) as shown in Test Figure 2. Apply pressure to the flow transducer harness until the slant tube manometer reads 1.5 cmH_2O.



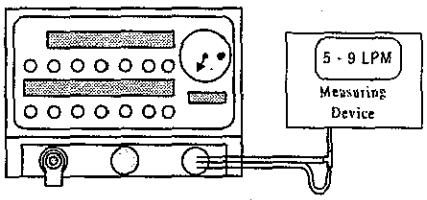
Test Figure 2

4.2 Verify that the monitor window reads 1500 ± 50. If transducer is in specification then skip the next step and record the result on the OVCS. IF THE FLOW TRANSDUCER GAIN IS OUT OF SPECIFICATION READJUST AS FOLLOWS:

A) Adjust R6 of the Flow Transducer PC Board so that 1500 ± 20 is displayed in the monitor window. Record the results on the OVCS.
B) Remove the slant tube manometer or the equivalent.

5.0 FLOW TRANSDUCER PURGE (P/N 50030A)

5.1 While in the BBR #5, tee the two tubes of the Flow Transducer Test Harness (P/N 10234) together and connect it to a flowtube (See Test Figure 3). Activate the Manual Breath button. The flow tube must read 5.0 to 9.0 LPM. Record the results on the OVCS.



Test Figure 3

5.2 Remove the Flow Transducer Test Harness (P/N 10234) and flow tube or equivalent from the unit.

6.0 PRESSURE TRANSDUCER VERIFICATION (P/N 09680)

NOTE : When zeroing airway and machine pressure transducers, don't have any test harnesses connected to the unit.

6.1 Activate the Select button, (BBR) display is number #6. The airway pressure will appear in the monitor window. Verify the monitor window reads 0.00 +1.00/-0.50 cmH_2O. If transducer is in specification then skip the next step and record the result on the OVCS.

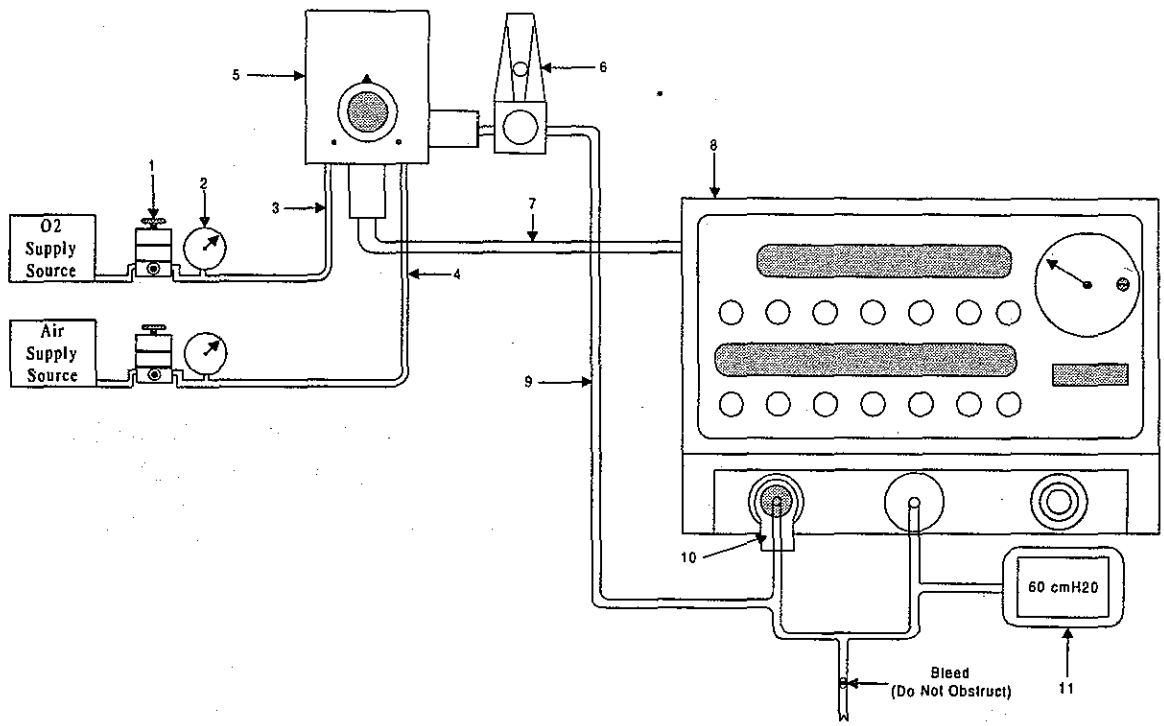
6.2 If out of specification then adjust trim Pot R1 Pressure Transducer PC Board to indicate 0.00 $\pm$ 0.25 cmH_2O in the monitor window. Record the result the OVCS.

6.3 Activate the Select button, (BBR) display is number #7. The Machine Pressure will appear in the monitor window. Verify the monitor window reads 0.00 $\pm$ 2.00 cmH_2O. If transducer is in specification then skip the next step and record the result on the OVCS.

6.4 If out of specification then adjust R3 on the Pressure Transducer PC Board to indicate 0.00 $\pm$ 0.25 cmH_2O in the monitor window. Record the result the OVCS.

6.5 Connect the Pressure Transducer Test Harness (P/N 03389) to the flowmeter on the 3800 blender auxiliary outlet (See Test Figure 4). Connect the Pressure Transducer Test Harness (P/N 03389) to the Prox Purge Test Housing (P/N 10233) and the patient outlet port. Tee in the master manometer. Slowly open the flowmeter until the master manometer reads 60.0 cmH_2O.

CAUTION : DO NOT occlude the Pressure Transducer Test Harness (P/N 03389) bleed orifice as this will cause over pressure damage to the transducers and the master manometer system.



Test Figure 4

1. 0 - 60 PSIG Pressure Regulator (QTY2)
2. P/N 00077 0 - 100 PSIG Inline Pressure Gauge (QTY2)
3. P/N 00060 oxygen hose
4. P/N 02899 air hose
5. P/N 03800 MicroBlender
6. P/N 09220 Flowmeter
7. P/N 03867 O_2 pressure hose
8. 8400 Ventilator to test
9. P/N 03389, Pressure Transducer Test Harness
10. P/N 10233 Prox Purge Test Housing
11. Digital master manometer 0-140 cmH_2O or equivalent

6.6 Press the Manual Breath button to revert back to, (BBR) #6 Airway Pressure. Verify the monitor window reads 60.0 $\pm$ 3.00 cmH_2O. If the transducer is in specification then skip the next step and record the result on the OVCS.

6.7 If out of specification then adjust R2 (Airway Pressure Gain) until 60.0 $\pm$ 1.25 cmH_2O is read in the monitor window. Record the result on the OVCS.

6.8 Activate the Select button, (BBR) display is the number #7. This is the Machine Transducer. Verify the monitor window reads 60.0 $\pm$ 3.00 cmH_2O. If the transducer is in specification then skip the next step and record the result on the OVCS.

6.9 If out of specification then adjust R4 (Machine Pressure Gain) until 60.0

± 1.25 cmH_2O is read in the monitor window. Record the result of the OVCS.

6.10 Take the test harness off the system and press the Manual Breath button and revert back to (BBR) #6. Check the zero on the Airway Pressure (#6) and the Machine Pressure (#7). It may have moved when you set the gain on the transducers. After you recheck the zero of the transducers, connect the test harness back up again. Induce the 60.0 cmH_2O to the test system. Using the Manual Breath and Select button toggle between #6 and #7 (BBR) and recheck the gain values.

6.11 With the above test set up, verify that the system manometer reads 60.0 ± 3.0 cmH_2O. If not, readjust the zero on the manometer. If still out of specification, replace the manometer. When you finish checking the manometer, remove the test harness. Check off the OVCS when you are finished with the test.

6.12 Activate the Select button, (BBR) display is number 8. The System Pressure will appear in the monitor window. Verify that the monitor window reads 20.0 ± 0.5 PSI. If transducer is in specification then skip the next step and record the result on the OVCS.

6.13 Adjust R9 on the Pressure Transducer PC Board to 20.0 ± 0.25 is indicated in the monitor window. Record the result on the OVCS. (System Pressure must agree to the Regulator Pressure by ± 0.25 PSIG when you finish adjusting R9.)

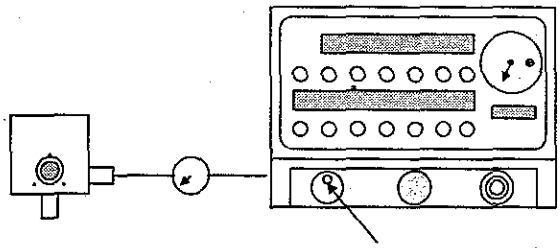
6.14 Apply torque seal (P/N S1020) to all trim pots you have adjusted.

7.0 AIRWAY PURGE AND FLOW VERIFICATION

7.1 With the Prox Purge Test Housing (P/N 10233) removed, occlude the airway pressure port at 12 o'clock position and adjust the Purge Valve (P/N 10180) until the pressure manometer reads 100 ± 5 cmH_2O. Record the result on the OVCS.

Summary of Transducer Calibration

Calibration Specification	Transducer	Operating Specification
103 ± 10	Flow Transducer Offset	103 ± 50
1500 ± 15	Flow Transducer Gain	1500 ± 50
0.00 ± 0.25 cmH_2O	Airway Zero	0.00 + 1.00/-0.50 cmH_2O
0.00 ± 0.25 cmH_2O	Machine Zero	0.00 ± 2.00 cmH_2O
60.00 ± 1.25 cmH_2O	Airway Gain	60.00 ± 3.00 cmH_2O
60.00 ± 1.25 cmH_2O	Machine Gain	60.00 ± 3.00 cmH_2O
20.00 ± 0.25 PSI	System Pressure	20.00 ± 0.5 PSI

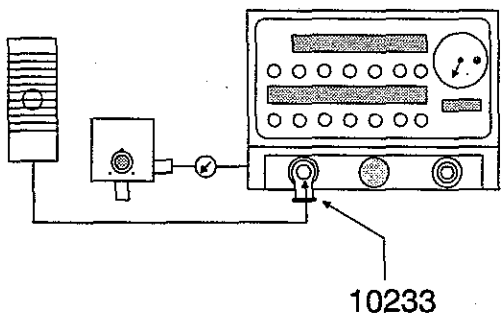


Airway Pressure Port
Test Figure 5

NOTE : If the airway pressure purge flow adjustment takes more then 10 seconds, the purge flow will stop because the Safety Valve and Solenoid will open. Remove occlusion momentarily to allow the purge flow to restart and complete 100 cmH_2O adjustment.

7.2 Apply torque seal (P/N S1020) to the Purge Valve stem at the valve body to maintain calibration.

7.3 Connect the tubing from the inlet of the Prox Purge Test Housing (P/N 10233) to the flowtube (See Test Figure 5). Flow must be 0.05 to 0.1 LPM. Record the result on the OVCS.
0.2



Test Figure 6

7.4 Remove Prox/Purge Test Harness (P/N 10233) and tubing from the ventilator. Install standard Exhalation Valve Body.

8.0 DISPLAY TEST

8.1 From BBR #8 System Pressure activate the Select button. This is the Display Light Test. Verify that all seven segment displays and the associated decimals illuminate. All point source LED's must also illuminate except for Vent INOP and Battery. Check off the OVCS.

9.0 WATCH DOG VENT-INOP VERIFICATION

9.1 While in the Display Test Mode position depress and hold the Silence and Reset buttons, momentarily press and release the Select button.

The unit's Vent INOP visual and audible alarm must activate. Fault code 250 must appear in the monitor display. Turn the ventilator power switch OFF and then ON. The ventilator should function normally. Check off the OVCS.

NOTE : If you have an Event Detection Module (EDM) the 250 will appear in the monitor window and also in the EDM.

10.0 CONTROL RANGE VERIFICATION

10.1 Connect Flow Transducer (P/N10081R) and press Reset. Rotate Tidal Volume control fully clockwise. Operate all remaining controls through their entire range to verify Min/Max endpoints according to the following chart.

NOTE : Off = Blinking "Off". If you use Flow Transducer (P/N 10302R). The Sensitivity display will read FXX (XX being the Sensitivity Setting).

CONTROL	MIN	MAX
Peak Flow	10	120
Breath Rate	0	80
PEEP/CPAP	0	30
Sensitivity	1	OFF
Pressure Support	OFF	50
High Pressure Limit	1	140
Low Peak Pressure	OFF	140
Low PEEP/CPAPPressure	-20	30
Low Minute Volume	0	60
High Breath Rate	3	150
Apnea Interval	10	60

10.2 Set PEEP/CPAP Control on Zero.Set Breath Rate control to 0, Peak Flow to 15 and rotate Tidal Volume and Backup Breath Rate through entire range. Check off the OVCS when you pass.

CONTROL	MIN	MAX
Tidal Volume	50	2000
Backup Breath Rate	0	80

(Tidal Volume must be 50 to get BBR of 80)

10.3 Disconnect Flow Transducer (P/N 10081R)and press Reset. Set Mode Control switch between waveform positions and verify that "four corner" rotating box occurs in monitor window and audible alarm is activated. Return waveform switch to A/C Squarewave mode and verify that visual and audible alarm cancels. Check off the OVCS.

11.0 MANUAL BREATH

11.1 Set the ventilator controls to standard settings (See below). Press the Manual Breath button. One pressure breath must be delivered. Check off the OVCS.

12.0 STANDARD CONTROL SETTING

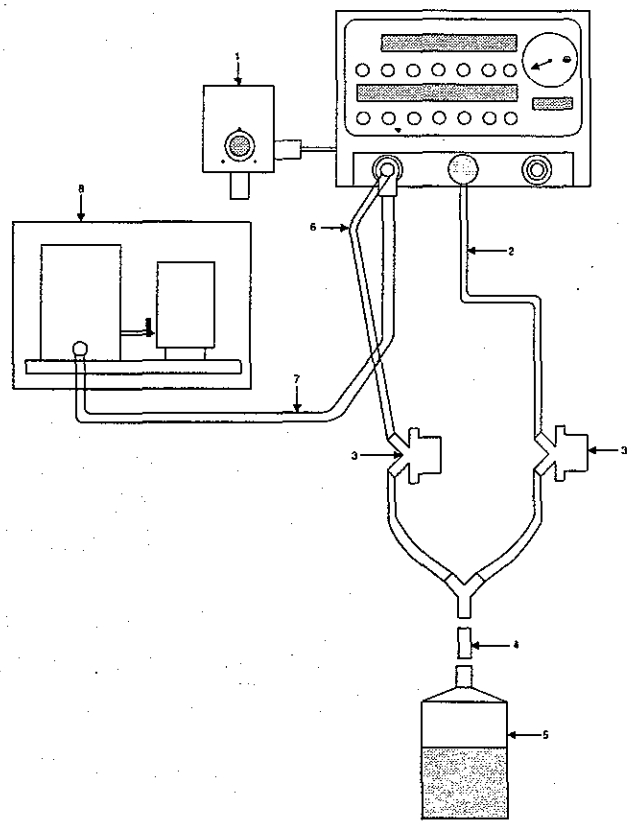
With the ventilator configured in accordance with Test Figure 7, and set the controls as follows:

MODE	**AC**	**HIGH PRESSURE LIMIT**	**140 cmH_2O**
WAVEFORM	**SQUARE**	**LOW PEAK PRESSURE**	**OFF**
TIDAL VOLUME	**800 mL**	**LOW PEEP/CPAP**	**-20 cmH_2O**
PEAK FLOW	**40 Lpm**	**LOW MINUTE VOLUME**	**7.0 L**
BREATH RATE	**10 Bpm**	**HIGH BREATH RATE**	**150 Bpm**
PEEP/CPAP	**5 cmH_2O**	**APNEA INTERVAL**	**60 sec.**
SENSITIVITY	**OFF**	**BACKUP BREATH RATE**	**0 Bpm**
PRESSURE SUPPORT	**OFF**		

Controls should remain in these positions unless specific instructions are given to change. When an instruction : ***RETURN TO STANDARD SETTINGS*** is given, place all controls to the settings shown above.

13.0 STANDARD VENTILATOR CONFIGURATION FOR TESTING

13.1 The ventilator must be configured with the patient circuit and ventilator accessories as shown in Test Figure 7. This configuration must be used for all verification tests in the following paragraphs, except as specifically noted.



Test Figure 7

1. P/N 03800 MicroBlender, set to 60% at 50 PSIG.
2. Inhalation portion of the patient circuit.
3. P/N 09413 water traps (2).
4. Endotracheal tube 7.0 mm ID X 20 cm long.
5. Standard test lung. 5 gallon (19 liters) rigid container. Rigid compliance chamber, C= 20 ml/cmH2O ± 5% filled with 22 LBS. (10 Kg) of fine copper wool.
6. Exhalation portion of the patient circuit.
7. Hose connection between Exhalation Valve Body and the spirometer, or it's equivalent, inlet.
8. An 8 Liter volume spirometer ± 2% accuracy with temperature compensation or equivalent.

14.0 TIDAL VOLUME VERIFICATION

14.1 Power ON the ventilator and **Return to Standard Settings** except for the following:

- Peak Flow 20 Lpm
- Breath Rate 5 Bpm
- PEEP/CPAP 0 cmH_2O
- Low Minute Volume - - -
  (No flow sensor connected.)

14.2 If the ventilator has not been running for 15 minutes, then let the ventilator warm up for 15 minutes before continuing with the test procedure.

14.3 If needed turn ON the volume measuring device (spirometer with temperature compensation or equivalent).

14.4 Between the end of exhalation and before the beginning of the next

inspiration, connect the hose from the outlet of the Exhalation Valve Body and the inlet of the spirometer or equivalent.

14.5 Collect 5 consecutive breaths in the spirometer or equivalent. Disconnect the spriometer or equivalent immediately after the 5th breath to avoid collecting additional purge flow.

14.6 Record the result on the OVCS. For the flow valve to pass the test, results must be 4.0 liters ± 10%.

14.7 Repeat steps **14.4 - 14.6** for the following settings :

- Set waveform to Peak Flow 20 Lpm.
- Set waveform to Peak Flow 60 Lpm.
- Set waveform to Peak Flow 120Lpm.

14.8 All the recorded values must be 4.0 liters ± 10% for the Tidal Volume readings.

14.9 When you have finished the testing then remove the tube between the Exhalation Valve Body outlet and the spirometer inlet. Leave the patient circuit in place.

15.0 MONITOR WINDOW VERIFICATION

15.1 Return to Standard Settings. Except for the following:

- Tidal Volume 500 mL
- Peak Flow 60 Lpm
- Breath Rate 12 Bpm
- PEEP/CPAP 0 cmH_2O

15.2 Connect Flow Sensor (P/N 10081R) to the ventilator.

NOTE : Let the ventilator deliver breaths for about 1 min. before the unit is ready to test. The sensor must read breaths before stabilizing.

15.3 Select Minute Volume in the monitor window. The value in the window should read 6L ± 0.9 L.

15.4 Select Tidal Volume in the monitor window. The value in the window should read 500mL ± 50 mL.

NOTE: For 8400ST ventilators, models 15020 ST or 15455, do step 15.5 and skip 15.6. For any other model 8400ST do step 15.6 and skip 15.5.

15.5 Select I : E ratio in the monitor window. The value in the window should read 1 : 7.7 ± 5.0%.

15.6 Select I : E ratio in the monitor window. The value in the window should read 1 : 7.3 ± 10.0%.

15.7 Select Breath Rate in the monitor window. The value in the window should read 12 Bpm ± 2Bpm.

15.8 Record the results on the OVCS for all monitored values.

15.9 When you have finished the Monitor Window Verification Test remove the flow transducer (P/N 10081R).

16.0 FLOW SUPPORT VERIFICATION (For ventilators with this option.)

16.1 Return to Standard Settings. Install the Flow Support (F/S) sensor (P/N 10302R). Set the LOW MINUTE VOLUME to 3.0 L.

NOTE : If CAL appears in the monitor window you need to calibrate the sensor. Block the patient wye and activate the Manual Breath button. The unit will calibrate (20 seconds). When the CAL is finished the unit will return to normal cycle mode.

16.2 The ventilator should recognize that the sensor has been installed. This will be indicated by an "F" in the Sensitivity display . The ventilator should deliver breaths at the set Breath Rate. Check off the OVCS Section III.

16.5 Allow the ventilator to operate for one minute. Use the Select button to check the following monitored values :

- MINUTE VOLUME 6.0 L ± 0.9 L
- TIDAL VOLUME 500 mL ± 75 mL
- I : E Ratio 1 : 7.3 ± 10%
- BREATH RATE 12 bpm ± 2 bpm

16.6 Record the results on the OVCS Section III. Remove sensor when finished.

17.0 PRESSURE CONTROL VERIFICATION (For ventilators with this option.)

17.1 Return to Standard Settings. Allow the ventilator to deliver 3 breaths. Press the Pres Ctrl button once. You should see the indicator light flashing. Also in the INSP PRESS and INSP TIME display will be a flashing "P". This indicates Pressure Control mode has been selected and to set the values.

17.2 Activate the Pres Ctrl button again. The indicator light will now be lit. Also the "P" in the display window for INSP TIME AND INSP PRESS will stop flashing. This indicates the ventilator is in Pressure Control mode. Let the ventilator deliver five (5) breaths.

17.3 To reset the ventilator back to volume ventilation, decrease the INSP PRESS to 5 cmH_2O (counterclockwise). Then press the Pres Ctrl button once. Now the indicator light and "P" in the display window will no longer be lit. Check off the OVCS Section V.

18.0 VOLUME ASSURED PRESSURE SUPPORT(For ventilators with this option.)

18.1 Return to Standard Settings. Activate the VAPS button. The indicator light will be lit. This indicates the ventilator is in VAPS mode. Let the ventilator deliver five breaths

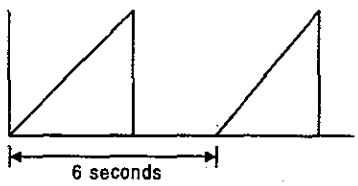
18.2 To deactivate VAPS press the VAPS button once. The indicator light will no longer be lit. This indicates VAPS mode has been deactivated. Check off the OVCS Section V.

RETURN TO STANDARD SETTINGS

19.0 BREATH RATE

19.1 Set Breath Rate to 10 Bpm. Measure the time interval between breaths using a stop watch while observing the pressure excursions on the manometer (beginning of inspiration to beginning of next inspiration).

19.2 Verify that the breath interval is 6.0 $\pm$ 0.2 seconds. This corresponds to 10 $\pm$ 0.3 Bpm . Check off the OVCS.

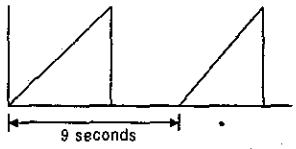


20.0 SIGH

20.1 Depress the SIGH button (ON). Verify that the indicator light is on.

20.2 With the stopwatch, time the interval from the beginning of inspiration to the beginning of the next inspiration. Verify that the time interval is 9 $\pm$ 0.2 seconds.

20.3 Depress the SIGH button (OFF). Verify that the indicator light is off. Check off the OVCS.



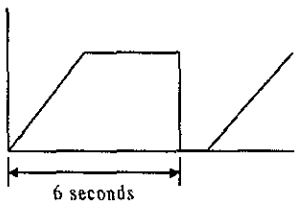
21.0 INSPIRATORY HOLD PERIOD

NOTE : For model numbers 15020 or 15336, with main eprom revision 10.71 or older, follow step **21.1**, and otherwise follow the directions under **21.2.**

21.1 Push in and hold Insp Hold button. While holding the Insp Hold button press the Manual Breath button (Proceed to 21.3).

21.2 Press and hold Insp Hold button. The monitor window will display I HLD. Press and the Select button.

21.3 With the I HLD running use a stopwatch to time the interval between the end of inspiration to beginning of exhalation. The time must be 6.0 $\pm$ 0.2 seconds. You can watch the system manometer to time the interval. It will go to peak pressure and hold at that pressure level. After 6 seconds the pressure will drop. Check off the OVCS.



22.0 PEEP/CPAP/SENSITIVITY/PRESSURE SUPPORT

22.1 Return to Standard Settings, except for the following :

- Mode AssistControl
- Tidal Volume 50 mL
- Peak Flow 10 Lpm
- Breath Rate 0 Bpm
- PEEP/CPAP 0 cmH_2O
- Assist Sensitivity 2 cmH_2O

Install Test Lung P/N 04845 to the patient circuit.

22.2 Squeeze the test lung to create a patient demand. The ventilator should deliver a breath once you have exceeded the Sensitivity setting. Verify the system manometer will read -2.0 $\pm$ 1.0 cmH_2O. Also the patient demand indicator will light. Check off the OVCS.

22.3 Set the ventilator as follows:

- Mode SIMV/CPAP square wave

- PEEP/CPAP 10 cmH_2O
- Pressure Support 20 cmH_2O

22.4 Squeeze the test lung until the ventilator delivers a breath. Verify the system manometer will read 30.0 $\pm$ 3.0 cmH_2O. Check off the OVCS.

22.5 Remove the test lung (P/N 04845) and reinstall the standard test lung.

23.0 APNEA/SILENCE/RESET

23.1 Return to Standard Settings, except for the following:

- Mode SIMV/CPAP square
- Breath Rate 0 Bpm
- PEEP/CPAP 15 cmH_2O
- Sensitivity 1 cmH_2O
- Apnea Interval 10 seconds

Activate the Manual Breath button. With a stopwatch, measure the elapsed time after the Manual Breath and the audible and visual Apnea alarm activation. The time must be 10.0 $\pm$ 1.0 second. Visual Apnea alarm includes flashing " AP " in Apnea Interval display window. Check off the OVCS.

23.2 Activate the Alarm Silence button. The elapsed time between the button activation and the alarm reinstatement must be 60.0 $\pm$ 5.0 seconds. Check off the OVCS.

23.3 Activate the Manual Breath button 3 times and the audible Apnea alarm must cancel. Activate the Reset button and the visual Apnea alarm must cancel.

24.0 REMOTE ALARM VERIFICATION (For ventilators with this option.)

24.1 To verify Remote Alarm you will need to plug in the Remote Alarm test harness into the Remote Alarm jack located on the back of the ventilator. Plug the other end into a DVM. Set the DVM to diode check.

24.2 Return to Standard Settings. Set the High Breath Rate Alarm to 3 Bpm. This will cause an audible and visual alarm. Visual alarm will be indicated by the flashing High Breath Rate display.

24.3 The Remote Alarm can be set to two (2) positions. Normally Open (N/O) or Normally Closed (N/C). N/O is the factory setting.

24.4 On your DVM, if you have a N/O setting, when the ventilator alarms the DVM reads as a closed diode. If you have a N/C setting, when the ventilator alarms the DVM reads a open diode.

24.5 Return the High Breath Rate Alarm to 15 Bpm. The audible alarm will reset. Press the Reset button and the visual alarm will reset. Check off the OVCS Section IV. Remove the Remote Alarm test harness.

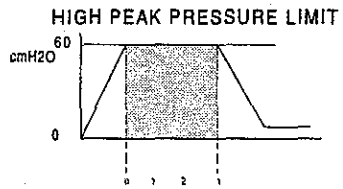
25.0 HIGH PEAK PRESSURE ALARM

25.1 Return to Standard Settings. Set the High Peak Pressure Alarm to 60 cmH_2O. Occlude (block) Exhalation Valve Body outlet.

25.2 Activate Manual Breath button and verify that the High Pressure Limit audible and visual (flashing display) alarms occur at 60.0 $\pm$ 6.0 cmH_2O. Check off the OVCS.

25.3 Measure the time from the initiation of the alarm to the initiation of the Safety Valve dump. The opening of the Safety Valve is noted by a fast decay of pressure on the system pressure gauge, a "rushing air" sound, and a flashing CIRC indication in the monitor window. This time should be 3.0 $\pm$ 0.5 seconds. Check off the OVCS.

25.4 Verify that the system pressure gauge pressure drops from 60.0 cmH_2O to within 3.0 cmH_2O of PEEP within 5 seconds.



25.5 Remove the blockage from the Exhalation Valve Body outlet, verify that audible alarm cancels.

25.6 Press Reset and verify "CIRC" cancels and that High Pressure Limit display stops flashing.

Return to Standard Settings.

26.0 LOW PEAK PRESSURE ALARM/ALARM LOUDNESS

26.1 Note the value of the peak pressure on the system manometer during the inspiratory cycle of the ventilator.

26.2 Between machine breaths, increase Low Peak Pressure Limit above the noted peak pressure.

26.3 Verify audible and visual alarms. Adjust the Alarm Loudness knob on the back of the unit to check the range of sound of the alarm.

26.4 Between machine breaths, decrease Low Peak Pressure Limit to OFF

and note audible alarm cancels and OFF flashes. Check off the OVCS.

27.0 LOW PEEP/CPAP PRESSURE ALARMS

27.1 Set Low PEEP/CPAP Pressure above PEEP/CPAP set value.

27.2 Verify audible and visual (flashing) alarms activation.

27.3 Set Low PEEP/CPAP Pressure to -20 cmH2O.

27.4 Verify audible alarms cancel. Press Reset and visual alarm cancels. Check off the OVCS.

28.0 LOW MINUTE VOLUME ALARM

28.1 Return to Standard Settings. Install the flow sensor 10081R. Let the ventilator deliver 10 breaths.

28.2 Set Low Minute Volume control to 8.5 Lpm. The Low Minute Volume audible and visual (flashing display) alarm must activate. Return control to 3.0 Lpm and the audible alarm cancels. Press Reset and the visual alarm will stop. Check off the OVCS.

29.0 HIGH BREATH RATE ALARM

29.1 Set High Breath Rate control to 3 Bpm. The High Breath Rate audible and visual (flashing) alarm must activate. Return control to 150 Bpm and the audible alarm will cancel, and press reset and the visual alarm will cancel. Check off the OVCS.

30.0 LOW INLET GAS PRESSURE ALARM

30.1 Return to Standard Settings. Reduce inlet pressure to 30.0 PSIG, on the inline gauge.

30.2 Set Pressure Support to 10 cmH_2O or above, and Sensitivity to 1 cmH_2O. Remove inspiratory hose from the patient output port on the ventilator.

30.3 Audible and Visual alarm for Low Inlet Gas will activate. Visual alarm is the LED.

NOTE: Ventilators built before April 1, 1996 will activate the Vent INOP alarm. Ventilators built after April 1, 1996 will activate the CIRC alarm and will not activate the Vent INOP alarm.

30.4 Reconnect inspiratory hose to the ventilator. Audible alarm will cancel.

Press Reset and the LED will no longer be lit. Check off the OVCS. Restore inlet gas pressure to 50.0 PSIG.

31.0 ELECTRICAL POWER DISRUPTION

31.1 Remove electrical power from the ventilator.

31.2 Verify audible and visual Vent INOP alarms. Verify Safety Valve opens, Flow Valve closes, and Exhalation Valve opens.

31.3 Restore electrical power to the ventilator. Verify the ventilator returns to normal operation (after power-up, self test sequence) and Vent INOP alarms cancel. Check off the OVCS.

32.0 LOSS OF GAS SUPPLY

32.1 Remove gas supply pressure.

NOTE: If your ventilator was built before April 1, 1996 (before S/N KGH02000) then follow the directions under steps **32.2 and 32.3.** If your ventilator was built after April 1, 1996 (S/N KGH02000 or higher) then follow the directions under steps **32.4** and **32.5.** Mark unused test on OVCS with a N/A.

32.2 Verify audible and visual Vent INOP and Low Inlet Gas alarms activate, and all other displays extinguish.

32.3 Restore gas supply pressure. Verify ventilator returns to normal operation after power-up self-test sequence and Vent INOP alarms cancel. Check off the OVCS.

32.4 Verify audible and visual Low Inlet Gas & CIRC alarms activate, Safety system opens and no breaths are delivered.

32.5 Restore gas supply pressure. Verify ventilator returns to normal operation. Check off the OVCS.

33.0 "CIRC" ALARM VERIFICATION

33.1 Remove the Exhalation Valve Body and block the Airway Pressure Port at 12:00 o'clock position. An audible and visual alarm must activate. Displayed in the monitor window must be a "CIRC".

33.2 Reconnect the Exhalation Valve Body to the ventilator and press Reset button. The ventilator must return to normal operation. Check off the OVCS.

34.0 ELECTRICAL SYSTEMS VERIFICATION

■ **Equipment Required:**
- Variac.
- Multimeter DVM, (AC) Voltmeter.

■ **Equipment Setup:**
- Turn ventilator OFF.
- Plug into Variac.
- Plug Variac power cord into properly grounded receptacle.
- Switch Variac ON.
- Adjust Variac to local power voltage.
- Switch the ventilator to the ON position.

35.0 ELECTRICAL POWER TOLERANCE AC TEST.

35.1 Return to Standard Settings. Set the ventilator input power to Minimum AC voltage required for operation. Use the following chart to determine the minimum voltage :

- For 100 volt AC units 85 volts AC
- For 120 volt AC units 102 volts AC
- For 220 volt ACunits 187 volts AC
- For 240 volt AC units 204 volts AC

35.2 Verify unit operates normally for 5 machine breaths. Check off the OVCS.

35.3 Adjust Variac to Maximum AC voltage required for operation. Use the following chart to determine the maximum voltage :

- For 100 volt AC units 110 volts AC
- For 120 volt AC units 132 volts AC
- For 220 volt AC units 242 volts AC
- For 240 volt AC units 264 volts AC

35.4 Verify unit operates normally for 5 machine breaths. Check off the OVCS.

35.5 Adjust Variac to "Brown Out" voltage. Use the following chart to determine the Brown Out voltage :

- For 100 volt AC units 70 volts AC
- For 120 volt AC units 85 volts AC
- For 220 volt AC units 154 volts AC
- For 240 volt AC units 168 volts AC

35.6 Verify that the ventilator at least briefly shows Vent Inop alarm (audible

and visual) activation followed by an attempt to power up and restart. Check off the OVCS.

35.7 Reset input power to normal voltage and verify return to normal operation. Set ventilator ON/OFF switch to OFF, remove power cord from Variac and silence Vent Inop audible alarm.

36.0 ELECTRICAL POWER TOLERANCE DC TEST

- **Equipment Required :**
  - DC Power Supply Source, 12-16 volts, 5 amps (minimum).
  - Digital multimeter.
  - P/N 08929 Power Source Cable Assembly.

- **Equipment Setup :**
  - Insert Alt Power Accessory Power Cable connector to socket on rear panel and the DC Power Supply source fitting.

36.1 Set AC Line/Alt Pwr AC/DC switch to Alt Pwr position (switch is on the rear panel).

36.2 Set the DC voltage to minimum voltage, 12 volts. Turn the DC source power supply ON. Verify normal operation for 5 breaths. The Battery indicator must be lit. Check off the OVCS.

36.3 Set the DC voltage to maximum, 16 volts. Verify normal operation for 5 breaths. The battery indicator must be lit. Check off the OVCS.

36.4 Turn the DC source power supply OFF. Disconnect Alt Power Accessory Power Cable. Set AC Line/Alt Power switch back to AC Line position. Insert ventilator power cord into proper grounded voltage receptacle. Turn the ventilator ON. It should return to normal operation after the initial start up.

36.5 Turn the ventiltor OFF. Disconnect power cord from power source.

37.0 GROUND CONTINUITY

37.1 Measure ground continuity between power cord ground and socket head cap screws on the bottom of the unit.

37.2 Verify ground resistance is less than 0.1 ohms. Record the result on the OVCS.

38.0 LEAKAGE CURRENT

38.1 Check for maximum leakage current by comparing Normal and Reverse Polarity in both Normally Open, and Normally Closed ground conditions.

38.2 Verify leakage current for Normal Polarity and Closed Ground (N/C) is less than 100 micro amps. Record the result on the OVCS.

38.3 Verify leakage current for Normal Polarity and Open Ground (N/O) is less than 100 micro amps. Record the result on the OVCS.

38.4 Verify leakage current for Reverse Polarity and Closed Ground (R/C) is less than 100 micro amps. Record the result on the OVCS.

38.5 Verify leakage current for Reverse Polarity and Open Ground (R/O) is less than 100 micro amps. Record the result on the OVCS.

39.0 DIELECTRIC TEST

CAUTION : High voltages are present during this test. "DO NOT TOUCH !!!" the ventilator or the power cord while test is in progress.

NOTE: You will only need to do this test if you disconnect the primary wires from the Power Entry Module.

39.1 Plug the ventilator into the Hi-pot tester receptacle.

39.2 Set the Hi-pot test voltage to 1200 VAC and the duration to 1 second. Leakage current setting of tester must be set to trigger at an equivalent resistance of 120K ohms.

39.3 Press start button for about 2 seconds. Check the insulator failure indicator. Record the result on the OVCS.

39.4 Unplug power cord from the tester. Make sure the tester is OFF before you touch the power cord.

40.0 EVENT DETECTION MODULE (EDM) (For ventilators with this option.)

40.1 When you finish checking the unit, you need to check the EDM. To access the EDM turn ventilator ON. Immediately after power is turned ON, depress and hold the Select and Manual Breath buttons. After a few seconds the ventilator will show a display in the PEEP/CPAP, SENSITIVITY, and PRESSURE SUPPORT windows. All other displays

will be blank. The Select and Manual Breath buttons can now be released. Check to see if error codes have been written to the EDM. "250" should be there from the Watch Dog VENT INOP. Check off the OVCS when you have finished checking the EDM Section II.

41.0 TOP COVER P/N 09698 ASSEMBLY

41.1 Install dustcover (P/N 08930) on top of flow control valve body.

41.2 Install, position tie wrap cable (P/N 05038) around valve body and dustcover. Cutoff and discard excess length of tie wrap cable.

41.3 Position top cover on manifold base.

41.4 Raise back of cover 1 to 1 $^{1}/_{2}$" upwards and rear area of slide panels outward.

41.5 Slide panel forward slip front lip under front panel housing.

41.6 Lower rear end of top cover down on base. From below of manifold base, insert screws (P/N 03222) with starwashers (P/N 02159) through manifold into top cover and secure using a $^{9}/_{64}$" Allen driver.

41.7 Clean external surfaces of ventilator with an appropriate bacterial or germicidal agent.

■ PERFORMANCE TEST

Prior to placing the 8400ST Volume Ventilator into clinical use, perform the following test:

WARNING:
If the 8400ST volume ventilator does not function as described below, refer the unit to a Bird trained service technician, your bird distributor or Bird Products Corp. technical service, 1100 Bird Center Drive, Palm Springs, CA. 92262, 800-934-2473 or (760) 778-7390. Do not use the ventilator until correct performance is verified.

1. Assemble the breathing circuit to the ventilator as outlined in Section 4. Assembly Instruction of this manual.
2. Attach flow transducer assembly. Refer to figure and instructions on page 4-4 and 4-5.
3. Attach a Test Lung (P/N 04845) to the patient wye (P/N 20225).
4. Attach air (P/N 02899) and oxygen (P/N 00060) supply hose to source gas outlets (wall or tank).
5. Turn source gas valves "open" and adjust pressure regulator to 50 PSIG $\pm$ 5 (3.50 kg/cm2).

WARNING:
Always operate the 8400ST/STi volume ventilator with clean/dry medical grade gases.

6. Connect the power cord to an appropriate electrical outlet.
7. Move the power module "On/Off" switch to the ON position (rear panel).

NOTE: Power up self test subsequent to initiating power to the ventilator (ON/OFF) a 5 second test is conducted. During the test the following occurs:

- Power "LED" turns "ON" and an audible alarm is briefly sounded
- Front panel LED's segmental display in unison
- Microprocessors verify communication
- Exhalation and Flow Control Valve "Home"
- Second audible alarm briefly sounds
- Front panel displays illuminate
- Ventilator begins to operate

8. Set operational parameters as follows:
   - Mode - Assist/Control, squarewave
   - Tidal Volume - 500 ml
   - Peak Flow - 60 lpm
   - Breath Rate - 12 bpm
   - PEEP/CPAP - 5 cmH_2O
   - Assists Sensitivity - "OFF"
   - Pressure Support - "OFF"

9. Set Alarm Parameters as follows: (Recommended settings for Performance Check "only").

   - **High Pressure Limit:** 5 cmH_2O above peak pressure reading on manometer.
   - **Low Peak Pressure:** 10 cmH_2O below peak pressure reading on manometer.
   - **Low PEEP/CPAP:** 2 cmH_2O below PEEP/CPAP reading on manometer.
   - **High Breath Rate:** 14 bpm.
   - **Low Minute Volume:** 4 L.
   - **Apnea Interval:** 20 seconds.
   - **Back Up Breath Rate:** 13 bpm.

10. Complete Circuit Pressure Test as follows:
    - Set Breath Rate Control to zero
    - Press Inspiratory Hold Button
    - Press Manual Breath Button
    - Circuit pressure should initially decrease slightly, plateau and hold following manual breath. If pressure rises then begins to decrease, check for circuit and/or humidifier leaks and correct.

NOTE: Refer to the 8400STi Operation Manual and Options, P/N L1297, for how to do IHLD on F/S units and PC/VAPS units.

11. Complete the following ventilator monitor performance checks:
    - Check that ventilator parameters are set as indicated in #8 above.
    - Allow ventilator to operate for two minutes.
    - Push the Monitor Select button to check the following monitored values:

Minute Volume	6 L ± 0.9 L
Tidal Volume	500 ml ± 75 ml
I:E Ratio	1:7.3 ± 10% or 1:7.5 ± 5%
Breath Rate	12 bpm ± 2 bpm

12. Complete the following alarm checks to verify the integrity of the audible/visual warnings:

    - **Power failure -** Remove power cord from electrical wall outlet. "Vent INOP" LED will illuminate, audible warning should sound, and display's will go blank. Reconnect power cord to cancel alarm and resume verification.

    - **High Pressure Limit -** Restrict test lung with hand. When ventilator cycles to inspiration a High Pressure Limit setting is violated The display will flash and audible alarm will sound briefly. At the same time, the ventilator should terminate inspiration and cycle to exhalation. Release test lung, then press the "RESET" button to cancel visual indicator and resume alarm verification.

    - **Low Peak Pressure - Low PEEP/CPAP Pressure -** Disconnect test lung from patient "Wye". Low PEEP/CPAP audible and visual alarms should activate followed shortly thereafter by a Low Peak Pressure visual alarm. Reattach test lung to patient "Wye" to cancel audible alarm once ventilator cycles. Press the "RESET" button to cancel visual indicator and resume alarm verification.

    - **Low Minute Volume -** Set breath rate control to 6 bpm. Audible and visual Low Minute Volume alarms should activate within 45 seconds. Readjust breath rate back to 12 bpm to cancel audible alarm, then press "RESET" button to cancel visual indicator and resume alarm verification.

    - **High Breath Rate -** Set breath rate control to 15 bpm. Audible and visual High Breath Rate alarms should activate within 45 seconds. Readjust breath rate back to 12 bpm to cancel audible alarm, then press "RESET" button to cancel visual indication and resume alarm verification.

    - **Apnea Interval/Apnea Backup Ventilation -** Adjust breath rate to 0 bpm. In approximately 20 seconds, the digital display for Apnea Interval should

begin to flash and the audible alarm should sound. The ventilator will now initiate Apnea Back Up Ventilation in the Assists/Control mode using the set Tidal Volume, Peak Flow and Backup Breath Rate. "AP" will flash in the monitored values digital display window. Press the "SILENCE" button to silence audible alarms. Readjust breath rate back to 12 bpm. Press "RESET" button to cancel visual indicator and resume alarm verification.

- **Flow Transducer Alarm Verification -** During operation of the ventilator, disconnect the flow transducer connector from the front of the ventilator. Upon removal, an audible alarm is sounded and the Low Minute Volume display flashes (- - -). Reconnect flow transducer to receptacle and audible alarm will silence. Press "RESET button to clear flashing display.

- **"CIRC" alarm and display -** During operation of the ventilator on the test lung, disconnect the circuit from the Exhalation Valve Body and occlude the end with your hand. As soon as the machine pressure transducer registers 29 cmH_2O (usually within the first breath after occlusion of the circuit with your hand), the monitor display window will begin to flash "CIRC" and the audible alarm will sound. Reconnect the circuit to the exhalation valve housing to cancel the audible alarm, then press the "RESET" button to cancel the visual indicator.

SHOULD THE 8400ST VOLUME VENTILATOR FAIL THE PERFORMANCE TEST AS OUTLINED ABOVE, AND YOU ARE UNABLE TO CORRECT THE PROBLEM, REFER UNIT TO A BIRD TRAINED TECHNICIAN, YOUR BIRD DISTRIBUTOR OR BIRD PRODUCTS CORPORATION FOR SERVICE.

8400 OPERATIONAL VERIFICATION CHECK SHEET

M/N : _____ **S/N :** _____

❒ EDM ❒ F/S ❒ PC/VAPS ❒ Remote Alarm

Section I

Procedure Reference	Description	Record Value (R)		Pass	Fail
15	Manometer "0" Adjust	XX	XXX		
1.3	Adjust Regulator 20.0 ± 0.5	R			
2.1	Flow Valve Homes & Display Cycles	XX	XXX		
2.1	Self Test Verification BBR & MW ON	XX	XXX		
2.2	Main Prom Version	R			
2.3	Power Prom Version	R			
2.4	Display Prom Version	R			
2.5	Pal Program Version	R			
	Begin 30Min. Warm Up Before Calibration				
3.1	Flow Transducer Zero 103 ± 50	R			
4.2	Flow Transducer Gain 1500 ±± 50	R			
5.1	Flow Transducer Purge 5.0-9.0 LPM	R			
6.1	Airway Pressure 0.0 +1.00/-0.5 cmH_2O	R			
6.2	Machine Pressure 0.0 ± 2.0 cmH_2O	R			
6.7	Airway Pressure 60.0 ± 3.0 cmH_2O	R			
6.8	Machine Pressure 60.0 ± 3.0 cmH_2O	R			
6.11	Verify Manometer Reads 60.0 ±3 cmH_2O	XX	XXX		
6.12	Adjust System (xducer) Pressure must agree to ± 0.3 cmH_2O of the Regulator.	R			
7.1	Prox Purge 100 ± 5 cmH_20	R			
7.3	Prox Purge Flow 0.05 - 0.10 LPM	R			
8.1	Display Illumination Test	XX	XXX		
9.1	Watch Dog Vent. Inop	XX	XXX		
10.2	Control Range Verification	XX	XXX		
10.3	Verify Mode Switch	XX	XXX		
11.1	Manual Breath Verification	XX	XXX		

This page may be duplicated for use.

Section I

Procedure Reference	Description	Record Value (R)		Pass	Fail
14.6	Tidal Volume Measurement ± 10%	R			
14.7	Tidal Volume Measurement ± 10%	R			
14.7	Tidal Volume Measurement ± 10%	R			
14.7	Tidal Volume Measurement ± 10%	R			
15.3	Monitor Check Minute Volume 6L±0..9L	R			
15.4	Monitor Check Tidal Volume 500mL±75mL	R			
15.5	Monitor Check I:E Ratio 1:7.5 ± 5%	R			
15.6	Monitor Check I : E Ratio 1:7.3 ± 10 %	R			
15.7	Monitor Check 12 bpm. ± 2 bpm				
19.2	Breath Rate 6.0 ± 0.2 seconds.	XX	XXX		
20.3	Sigh Breath 9.0 ± 0.2 seconds	XX	XXX		
21.3	Inspiratory Hold 6.0 ± 0.2 seconds	XX	XXX		
22.2	Sensitivity Verification	XX	XXX		
22.4	PEEP/CPAP and Pressure Support Verification	XX	XXX		
23.1	Apnea Alarm 10 ± 1 sec. and Reset	XX	XXX		
23.2	Alarm Silence 60.0 ± 5 seconds	XX	XXX		
25.2	High Peak Pressure Alarm 60.0 ± 6 cmH_20	XX	XXX		
25.3	"CIRC" alarm Activation & Reset	XX	XXX		
25.4	Safety Valve Activation 3.0 ± 0.5 seconds	XX	XXX		
26.4	Low Peak Pressure Alarm & Reset	XX	XXX		
27.4	Low PEEP/CPAP Alarm & Reset	XX	XXX		
28.2	Low Minute Volume Alarm	XX	XXX		
29.1	High Breath Rate Alarm	XX	XXX		
30.4	Low Inlet Gas Pressure Alarm & Reset	XX	XXX		
31.3	Vent. Inop. & Reset	XX	XXX		
32.3	Loss of Gas Alarm & Reset	XX	XXX		
32.5	Loss of Gas Alarm & Reset	XX	XXX		
33.2	"Circ" Alarm & Reset	XX	XXX		
35.2	Minimum A.C. Voltage	XX	XXX		
35.4	Maximum A.C. Voltage	XX	XXX		
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36.2	Minimum D.C. Voltage	XX	XXX		
36.3	Maximum D.C. Voltage	XX	XXX		
37.2	Ground Continuity $\leq$ 0.1 ohms	R			
38.2	Leakage Current N/C 100 micro amps.	R			
38.3	Leakage Current N/O 100 micro amps.	R			
38.4	Leakage Current R/C 100 micro amps.	R			
38.5	Leakage Current R/O 100 micro amps.	R			
39.3	Dielectric Test	XX	XXX		

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Section II

Procedure Reference	Description	Record Value (R)		Pass	Fail
17	Check EDM for all fault codes, before cal.	XX	XXX		
40.1	Check EDM for all fault codes, after cal.	XX	XXX		

Section III

Procedure Reference	Description	Record Value (R)		Pass	Fail
16.2	Sensor Recognition Verification: (1) Vent. must "trigger" & deliver gas(2) "F" must appear in SENSITIVITY display window.	XX	XXX		
16.5	Monitor Check Minute Volume 6L ± 0.9L	XX	XXX		
16.5	Monitor Check Tidal Volume 500mL±75mL	XX	XXX		
16.5	Monitor Check I:E Ratio 1: 7.3 ± 10%	XX	XXX		
16.5	Monitor Check Breath Rate 12 bpm ± 2 bpm	XX	XXX		

Section IV

Procedure Reference	Description	Record Value (R)		Pass	Fail
24.5	Remote Alarm Verification	XX	XXX		

Section V

Procedure Reference	Description	Record Value (R)		Pass	Fail
17.3	Pressure Control Check & Reset	XX	XXX		
18.2	VAPS Check & Reset	XX	XXX		

Section VI

General Inspection : Clean the top cover, front display, back panel, and ect.. Check for proper labels. Check the input voltage configuration to make sure it is set proper for the model type unit indicated. Make sure any literature need for updates or upgrades is included with the unit when it is shipped.

Section VII Critical Component Tracking

Part #	Description	Lot code Number	Serial Number

I here by certify that the product with above Serial Number has passed all operational specifications and is certified for clinical use. (The unit must be signed off before returning to clinical use.)

Signature: _____

Date: _____

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SECTION 15

Troubleshooting

SECTION 15
TROUBLESHOOTING

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PROBLEM	POTENTIAL CAUSE	CORRECTIVE ACTION
VENT INOP - Non Recoverable During normal operation the ventilator shuts down indicating Ventilator Inoperative. Vent Inop light is ON but all other displays are OFF. Audible alarm is sounding. Unit remains in Vent Inop condition until power is turned OFF then ON again. Error code may be displayed in monitor window.	1. System failure.	1. Retrieve fault and/or status code from EDM module and refer to the APPENDIX for details.
VENT INOP - Momentary During normal operation the ventilator shuts down indicating Ventilator Inoperative. The Vent Inop light is ON but all other displays are OFF. Audible alarm is sounding. Without interaction by user the ventilator resumes or attempts to resume normal operation.	1. Low inlet gas. 2. Input power (AC or DC) out of tolerance range. 3. Intermittent system failure.	1. Check gas source pressure, blender system, and inlet filter. 2. Check power entry module and power supply. 3. Test Main, Power, Pressure XDCR, and Display PCB.
VENT INOP - Other During normal operation the ventilator shuts down. Power light is ON, Vent Inop light is ON, but all other displays are OFF. Audible alarm is sounding. Unit remains in Vent Inop condition even after power is turned OFF then ON again.	1. Inlet gas supply too low. 2. AC or DC power input out of tolerance range. 3. Defective pressure regulator. 4. Electronic system failure.	1. Check gas source pressure, blender system, and inlet filter. 2. Check power entry module and power supply. 3. Replace pressure regulator.

PROBLEM	POTENTIAL CAUSE	CORRECTIVE ACTION
Ventilator unable to power up: AC or DC operation. Power light ON, Vent Inop light is ON, and audible alarm is sounding.	**1.** Inlet gas supply too low.	1. Check gas source pressure, blender system, and inlet filter.
	2. AC or DC power input out of tolerance range.	2. Check power entry module and power supply.
	3. Defective pressure regulator.	3. Replace pressure regulator.
	4. Electronic system failure:	4. Retrieve fault and/or status codes from EDM module and refer to APPENDIX for details.
Ventilator unable to power up: AC operation, Power light is OFF, VENT INOP light is OFF, all other displays are OFF, and audible alarms are OFF.	**1.** Power Cord not plugged into wall or back of unit.	**1.** Connect Power cord properly.
	2. Fuse blown or missing in ON/OFF switch power entry module.	**2.** Replace fuse.
	3. AC LINE/ALT Power switch on back panel set to ALT power operation.	**3.** Switch to AC LINE position.
	4. No power at wall outlet.	**4.** Use alternate wall outlet.
	5. Power transformer failure.	**5.** Return to BIRD.
	6. Internal fuse on Power Supply PCB blown.	**6.** Replace 03794 Fuse.
	7. Defective power entry module.	**7.** Replace power entry module.
	8. Defective Power PCB and/or voltage regulators.	**8.** Replace 50020 Power PCB or voltage regulators.

PROBLEM	POTENTIAL CAUSE	CORRECTIVE ACTION
Ventilator unable to power-up: 12 volt operation Power light is OFF, VENT INOP light is OFF, all other displays are OFF, and audible alarms are OFF.	**1.** AC LINE/ALT Power switch on back panel set to AC operation.	**1.** Switch to DC ALT Power position.
	2. External power supply (battery) has lost its charge.	**2.** Replace with fully charged battery.
	3. External power supply cable not correctly connected or defective.	**3.** Return to BIRD.
	4. Internal fuse on Power Supply PCB blown.	**4.** Replace internal fuse.
	5. Power PCB and/or voltage regulators defective.	**5.** Replace 50020 Power PCB or voltage regulators.
	6. System failure.	**6.** Retrieve fault and/or status codes from EDM module and refer to APPENDIX.
Unstable Displays One or more of the control or alarm values are changing without user interaction. The change is within ± 1 increment of specified values. (E.G. Vt change from 800 ml to 810 ml is consider 1 increment)	**1.** Control set in between settings.	**1.** Adjust control knob.

PROBLEM	POTENTIAL CAUSE	CORRECTIVE ACTION
Unstable Displays One or more of the control or alarm values are changing without user interaction. The change is more than +/- 1 increment of specified value.	1. Defective Display PCB. 2. Defective cable between Display PCB and Main PCB Cable.	1. Replace 50000 Display PCB. 2. Replace 15115 and 15118 Cables.
Unreadable Displays One or more LED segments on the display panel is malfunctioning.	1. Defective LED's on the display board.	1. Replace 03773 7-segment LED or the 50000 Display PCB.
Volume Delivery Errors: Min./Tidal volume Volume displayed in volume monitor window does not match within 10% of the control settings during a controlled breath.	1. Leaks in the patient circuit (including humidifier). 2. Exhalation valve diaphragm not properly installed. 3. Internal system leak. 4. Regulator not properly adjusted. 5. Defective flow valve. 6. Minute volume calculated from control settings was calculated incorrectly. 7. Defective Flow Transducer.	1. Check patient circuit and correct any leaks. 2. Install diaphragm properly. 3. Check outlet manifold for leaks and correct. 4. Adjust regulator properly. 5. Replace 09740 Flow valve. 6. Recalculate minute volume. 7. Replace Flow Transducer.

PROBLEM	POTENTIAL CAUSE	CORRECTIVE ACTION
Exhalation Valve Noise During any phase of ventilation the exhalation valve makes a loud, clanking sound. Loss of PEEP may occur.	**1.** Defective valve.	**1.** Replace 10083 Exhalation valve.
	2. Sticky valve stem.	**2.** Replace 10083 Exhalation valve.
	3. Defective Power board.	**3.** Replace 50020 Power PCB.
	4. Contaminated/dirty exhalation diaphragm.	**4.** Clean diaphragm.
Low PEEP/CPAP Alarm and/or **Low PEAK PRESSURE Alarm**	**1.** Leak in patient circuit (including humidifier).	**1.** Check patient circuit and correct problem.
	2. Alarm set too high.	**2.** Verify proper alarm setting and correct if necessary.
	3. Exhalation valve diaphragm not installed properly.	**3.** Insert diaphragm correctly.
	4. Exhalation valve out of calibration.	**4.** Replace 10083 Exhalation valve.
Low INLET GAS Alarm	**1.** Low gas pressure at inlet.	**1.** Connect 50 psi source to gas inlet port.
	2. Pressure regulator out of adjustment.	**2.** Adjust pressure regulator properly.

PROBLEM	POTENTIAL CAUSE	CORRECTIVE ACTION
***CIRC* Alarm** The letters *circ* appear in the monitor window, usually accompanied by audible alarm.	**1.** Patient circuit is occluded. **2.** Proximal line is occluded or disconnected. **3.** Outlet filters occluded. **4.** XDCR PCB out of calibration or defective. **5.** Defective ribbon cable between main and XDCR PCB.	**1.** Remove any occlusions in patient circuit. **2.** Connect proximal line correctly and insure that there are no kinks or occlusions. **3.** Replace filters and remove any obstructions. **4.** Replace or calibrate 9680 XDCR PCB. **5.** Replace 08938 Ribbon cable.
Low Minute Volume Alarm:	**1.** Leak in patient circuit. **2.** Alarm set too high. **3.** Defective Flow Transducer.	**1.** Check circuit for leaks and correct problem. **2.** Readjust alarm. **3.** Replace Flow Transducer.
"—" in window.	**1.** Flow Transducer not installed correctly. **2.** Defective Flow Transducer.	**1.** Reinstall correctly. **2.** Replace Flow Transducer.
"0" Minute Volume reading.	**1.** Flow transducer not connected to Exhalation Valve properly. **2.** Defective Flow Transducer.	**1.** Check for proper connection and fix. **2.** Replace Flow Transducer.

PROBLEM	POTENTIAL CAUSE	CORRECTIVE ACTION
Autocycling Ventilator triggers controlled breaths immediately after exhalation of the previous breath (at a rate higher than the control setting).	**1.** Sensitivity set too low for lung conditions.	**1.** Adjust sensitivity to the proper setting for the present lung conditions.
	2. Patient circuit leak.	**2.** Check patient circuit and correct problem.
	3. Exhalation diaphragm.	**3.** Check to insure that diaphragm is installed properly.
	4. Exhalation valve out of calibration.	**4.** Replace 10083 Exhalation valve.
	5. XDCR out of calibration.	**5.** Calibrate proximal XDCR properly.
Pressure Control Errors Inaccurate or unstable PEEP or PRESSURE SUPPORT.	**1.** Patient circuit leak.	**1.** Check patient circuit and correct any problems.
	2. Internal system leak.	**2.** Check patient outlet manifold for leaks. Return to BIRD.
	3. Exhalation diaphragm.	**3.** Check to insure that diaphragm is installed properly.
	4. Pressure XDCR out of calibration.	**4.** Calibrate 9680 XDCR PCB properly or replace.
No Gas Flow No gas is flowing through the outlet port of ventilator but the ventilator is cycling in CTRL mode or the patient effort light is illuminated in ASST or SIMV modes.	**1.** Defective flow valve.	**1.** Replace 09740 Flow valve.

PROBLEM	POTENTIAL CAUSE	CORRECTIVE ACTION
Failure to Trigger:		
Manometer indicates a negative pressure.	**1.** Sensitivity set too high or OFF.	**1.** Adjust Sensitivity
	2. Defective pressure XDCR.	**2.** Calibrate 9680 XDCR PCB or replace.
	3. Defective Flow valve.	**3.** Replace 9740 Flow valve.
PEEP = 0 and manometer reads 0 and does not move.	**1.** Safety valve held open.	**1.** Replace safety valve.
	2. Leak in system.	**2.** Repair leak or return to BIRD.
	3. Leak in patient circuit.	**3.** Check that patient circuit is connected properly.

SECTION 15
TROUBLESHOOTING - APPENDIX

CODE	DESCRIPTION	PROBLEM/SOLUTION
0	No error.	Normal operation.
1	Motor processor failed to communicate with Main processor following power up.	A problem exists on the serial communication bus between the Main Board and the Power Board. Check J1 cable, 50020 Power board, and 50280 Main board.
2	Invalid status in serial interface transmit function.	A problem exists in the processor u22 on the Main board. Check the 50280 Main board.
3	PAL in reset state.	These are Status codes only. A problem exists in the u22 processor / u25 PAL on the Main board. Check 50280 Main board.
4	PAL detected single error.	See code 3.
5	PAL detected double error.	See code 3.
6	EPROM checksum test failed.	The EPROM u24 is checked with a checksum at power up to insure that the EPROM is good. A checksum failure indicates a bad EPROM. Check 50280 Main board and EPROM u24.
7	EPROM CRC test failed.	The EPROM u24 is checked with a Cyclical Redundancy Check. This fault has been disenabled and should not occur.
9	Proximal and Machine pressure data do not match sufficiently.	Status code only. Will result in a *CIRC* alarm. Check patient circuit, calibration and function of 9680 XDCR board.
10	Flow valve failed to home promptly in exhalation XFIZ.	Status code set after 120 milliseconds, and fault code after 1.8 seconds. Check Flow valve, Flow valve connector J7, and 50020 Power board.

CODE	DESCRIPTION	PROBLEM/SOLUTION
11	Flow valve failed to home promptly in exhalation XCUT.	See code 10.
12	Exhalation valve failed to position promptly in exhalation XPOP.	Status code after 120 milliseconds and fault code after 1.8 seconds. Check Exhalation valve, Exhalation valve connector J6, and the 50020 Power board.
13	Exhalation valve failed to position promptly in exhalation XCUT.	See code 12.
14	Exhalation valve not promptly at home for start of exhalation XPOP.	See code 12.
15	Flow valve failed to close promptly for start of exhalation XTOP.	See code 10.
16	Exhalation valve positioning delayed over 240mS by home in progress XPOP.	See code 12.
17	Exhalation valve positioning delayed over 240mS by home in progress XCUT.	See code 12.
20	Exhalation valve not closed for start of Square Wave inspiration.	See code 12.
21	Flow valve failed to open promptly in Square Wave inspiration.	See code 10.
22	Flow valve failed to close promptly in Square Wave inspiration.	See code 10.
25	Exhalation valve not closed for start of Decelerating Taper inspiration.	See code 12.

CODE	DESCRIPTION	PROBLEM/SOLUTION
26	Flow valve failed to open promptly in Decelerating Taper inspiration.	See code 10.
27	Flow valve failed to close promptly in Decelerating inspiration.	See code 10.
28	Decelerating Taper inspiration delayed over 240mS by exhalation home in progress.	See code 12.
30	A/D #1 over range in front panel control potentiometer read.	Caused by open inputs from panel control potentiometers. Check cable J3, 50000 Display board, and 50280 Main board.
31	A/D #2 over range in front panel control potentiometer read.	See code 30.
32	A/D #1 and A/D #2 multiplexor data does not match in front panel control potentiometer read.	Caused by different inputs to the analog to digital converters coming from the front panel potentiometers or faulty IC's (u13 thru 21). Check the 50280 Main board.
33	A/D #1 and A/D #2 data does not match in front panel control potentiometer read.	See code 32.
40	A/D #1 over range in proximal pressure read - simulated full scale data created.	Caused by an open or over range pressure transducer input to the Main board. These are status codes only, but because simulated data is created, they may trigger a fault code 42-44, 52-54, or 62-64 if the two A/D converters data dd not match. Check the J4 cable, the 9680 XDCR board, and the 50280 Main board.
41	A/D #2 over range in proximal pressure read - simulated full scale data created.	See code 40.

CODE	DESCRIPTION	PROBLEM/SOLUTION
42	A/D #1 and A/D #2 data do not match in proximal pressure read, #1 >> #2.	Caused by different inputs to the analog to digital converters, u16 and u20, coming from the pressure XDCR on the 9680 XDCR board or faulty IC's (u13 thru 21). Check the 50280 Main board.
43	A/D #1 and A/D #2 data do not match in proximal pressure read, #2 >> #1.	See code 42.
44	A/D #1 and A/D #2 data do not match in proximal pressure read - data similar.	See code 42.
50	A/D #1 over range in machine pressure read - simulated full scale data created.	See code 40.
51	A/D #2 over range in machine pressure read _ simulated full scale data created.	See code 40.
52	A/D #1 and A/D #2 data do not match in machine pressure read, #1 >> #2.	See code 42.
53	A/D #1 and A/D #2 data do not match in machine pressure read, #2 >> #1.	See code 42.
54	A/D #1 and A/D #2 data do not match in machine pressure read, data similar.	See code 42.
60	A/D #1 over range in inlet regulator pressure read, simulated data created.	See code 40.
61	A/D #2 over range in inlet regulator pressure read, simulated data created.	See code 40.

CODE	DESCRIPTION	PROBLEM/SOLUTION
62	A/D #1 and A/D #2 data do not match in regulator pressure read, #1 >> #2.	See code 42.
63	A/D #1 and A/D #2 data do not match in regulator pressure read, #2 >> #1.	See code 42.
64	A/D #1 and A/D #2 data do not match in regulator pressure read, data similar.	See code 42.
70	A/D #1 over range in 2.5 volt test reference read.	The 2.5 volt reference supply is faulty on the Main board. Check the 50280 Main board.
71	A/D #1 too high in 2.5 volt reference read.	See code 70.
72	A/D #1 too low in 2.5 volt test reference read.	See code 70.
73	A/D #1 does not match A/D #2 in 2.5 volt test, #1 > #2.	See code 70.
75	A/D #2 over range in 2.5 volt test reference read.	See code 70.
76	A/D #2 too high in 2.5 volt test reference read.	See code 70.
77	A/D #2 too low in 2.5 volt test reference read.	See code 70.
78	A/D #2 does not match A/D #1 in 2.5 volt test #2 > #1.	See code 70.

CODE	DESCRIPTION	PROBLEM/SOLUTION
80	A/D #1 over range in potentiometer reference read.	The microprocessor found that V_{POT} supply was incorrect compared to the $5V_A$ during power up self test. Fault code 81, 82, 86, and 87 set a status code when first error occurs. A second attempt is made to check V_{POT}. If the second attempt fails, then a fault code is generated. Check the J4 cable, the 9680 XDCR board, and the 50280 Main board.
81	A/D #1 too high in potentiometer reference read.	See code 80.
82	A/D #1 too low in potentiometer reference read.	See code 80.
85	A/D #2 over range in potentiometer reference read.	See code 80.
86	A/D #2 too high in potentiometer reference read.	See code 80.
87	A/D #2 too low in potentiometer reference read.	See code 80.
90	Cannot find mode switch when Patient Effort detected in exhalation.	The mode switch input is faulty. Look for the open mode switch indicator (rotating segments) in the monitor display. Check the J3 cable, 50000 Display board, and the 50280 Main board.
91	Cannot find mode switch when Volume Breath is to be delivered with breath rate timer rest in exhalation.	See code 90.
92	Cannot find mode switch when Volume Breath is to be delivered without breath rate timer reset in exhalation.	See code 90.

CODE	DESCRIPTION	PROBLEM/SOLUTION
100	Internal RAM memory test failed pass 1 (invert bit DPL, byte B).	Internal RAM of the processor u22 is checked on power up. This fault code indicates a defective processor on the Main board. Check the 50280 Main board.
101	Internal RAM memory test failed pass 1 (read/verify, byte DPH).	See code 100.
102	Internal RAM memory test failed pass 2 (invert bit DPL, byte B).	See code 100.
103	Internal RAM memory test failed pass 2 (read/verify, byte DPH).	See code 100.
105	External RAM 0 memory test failed pass 1 (invert bit B, byte R0).	External RAM memory u29 of the Main board is checked on power up. This fault indicated defective EPROM or Main board. Check 50280 Main board.
106	External RAM memory 0 test failed pass 1 (read/verify, byte R1).	See code 105.
107	External RAM memory 0 test failed pass 2 (invert bit B, byte R0).	See code 105.
108	External RAM memory 0 test failed pass 2 (read/verify, byte R1).	See code 105.
110	Exhalation valve failed to home at system start up.	Exhalation valve did not go to Home position, or failed to position during start up. This is a status code initially. After 2 seconds it will become a fault code if the valve is still not at home (code 110) or in position (code 111). Check Exhalation valve, exhalation valve connector J6, and 50020 Power board.

CODE	DESCRIPTION	PROBLEM/SOLUTION
111	Exhalation valve failed position trial at system start up.	See code 110.
112	Flow valve failed to home at system start up.	Flow valve failed to home during start up. The first failure sets a status code; the second failure sets a fault. Check Flow valve, Flow valve connector J7, and the 50020 Power board.
117	Proximal and Machine pressure data do not match sufficiently during exhalation.	Status code only. Will result in a *CIRC* alarm. Check patient circuit, calibration and function of 9680 XDCR board.
119	Exhalation valve not closed for start of servo inspiration.	The Exhalation valve should have been closed at this time (beginning of servo inspiration) but was not. Check Exhalation valve, Exhalation valve connector J6, and the 50020 Power board.
190	Communication fault - Motor processor reports lost data byte(s) from Main processor.	Status code only. The Motor processor (on the Power board) reported lost header information and/ or data from the Main processor (or vice versa). Check cable J1, the 50020 Power board, and the 50280 Main board.
191	Communication fault - Motor processor reports lost header from Main processor.	See code 190.
192	Communication fault - Main processor reports lost data byte(s) from Motor processor.	See code 190.
193	Communication fault - Main processor reports lost header from Motor processor.	See code 190.

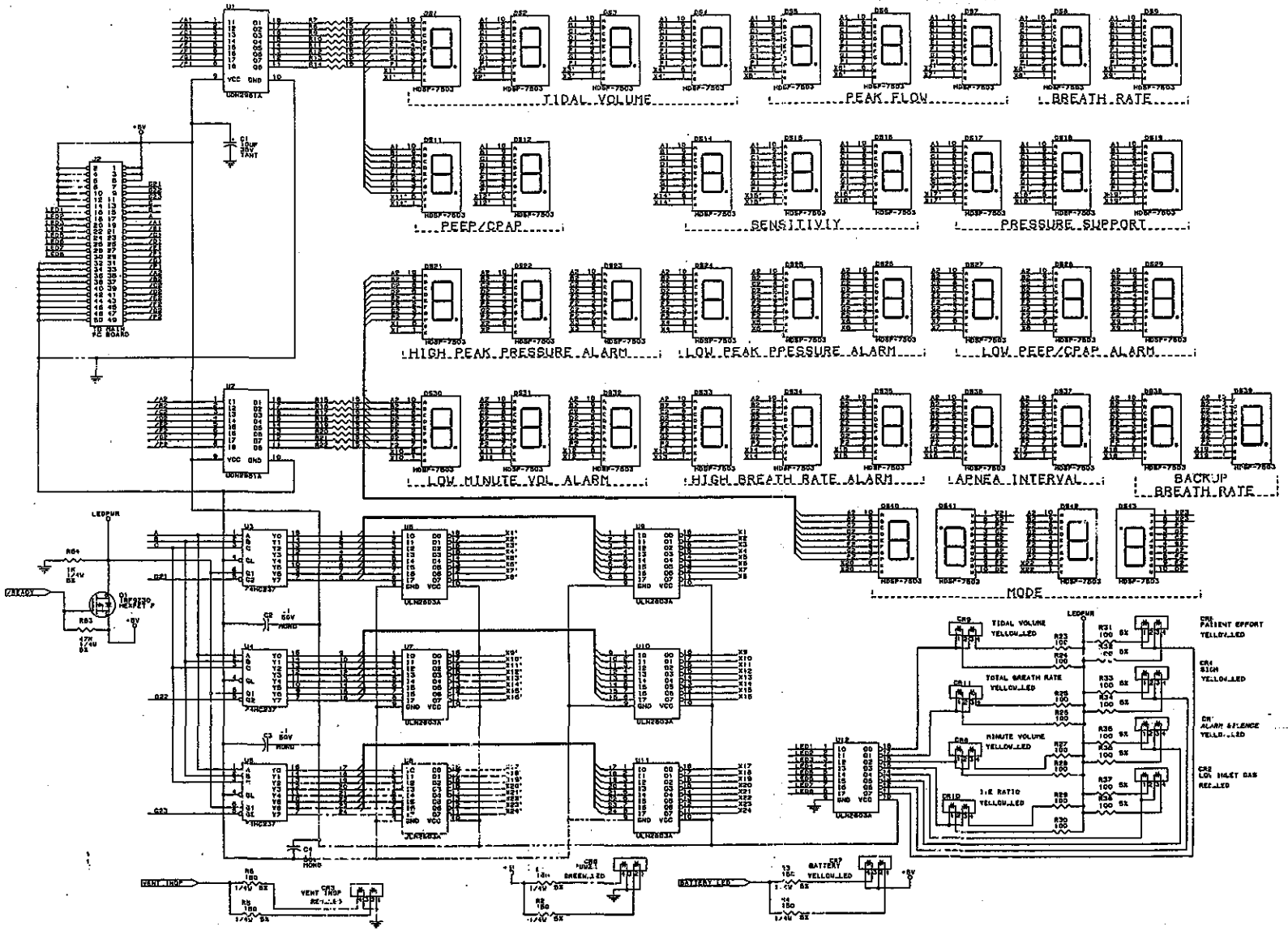
CODE	DESCRIPTION	PROBLEM/SOLUTION
199	Warning - 1mS interrupt too slow.	This is a status code only indicating that the 1 millisecond timer is too slow. Check 50280 Main board.
200	Low inlet gas alarm activated.	This is a status code only indicating low inlet gas pressure. Check inlet gas, 20 psi regulator adjustment, and the 9680 XDCR board calibration. If the pressure drops too low, a VENT INOP is forced by the fault monitor circuit of the Main board independent of this status.
210	Motor processor encountered illegal flow valve motion control state 00.	Illegal codes encountered by the Motor processor on the Power board. This indicates a bad processor u3 on the Power board. Check 50020 Power board.
211	Motor processor encountered illegal flow valve motion control state 0D.	See code 210.
212	Motor processor encountered illegal flow valve motion control state 10.	See code 210.
213	Motor processor encountered illegal flow valve motion control state 1D.	See code 210.
215	Motor processor encountered illegal exhalation valve motion control state 00.	See code 210.
216	Motor processor encountered illegal exhalation valve motion control state 0D.	See code 210.
217	Motor processor encountered illegal exhalation valve motion control state 10.	See code 210.

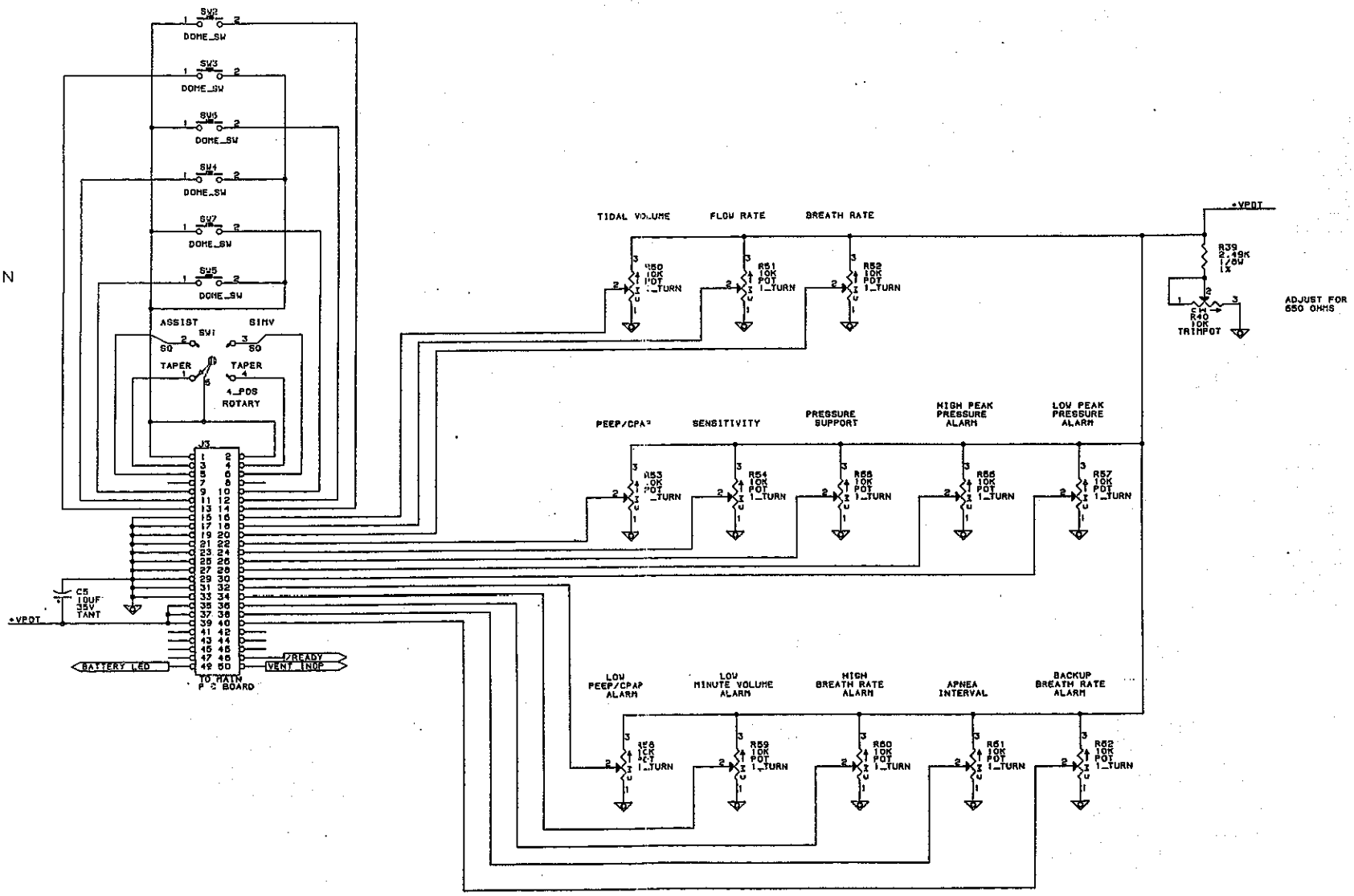
CODE	DESCRIPTION	PROBLEM/SOLUTION
218	Motor processor encountered illegal exhalation valve motion control state 1D.	See code 210.
220	Motor processor Internal RAM memory test failed pass 1 (invert @SP, bit B should not be set).	The motor processor has bad internal RAM or the EPROM software is bad on the Power board. Check 50020 Power board.
221	Motor processor Internal RAM memory test failed pass 1 (read/verify, byte R0).	See code 220.
222	Motor processor Internal RAM memory test failed pass 2 (invert @SP, bit B should not be clear).	See code 220.
223	Motor processor Internal RAM memory test failed pass 2 (read/verify, byte R0).	See code 220.
230	Motor processor timed out awaiting communication from the main processor.	Status code only. The Power board processor did not receive any transmitted data from the Main processor. Check J1 cable, the 50020 Power board, and the 50280 Main board.
236	Motor processor program memory checksum test failed.	See code 220.
250	Operator initiated safety system test.	This fault is initiated by the operator and does not indicate a fault with ventilator.

SECTION 16

Schematics - Drawings

DRAWING 50002 (1 of 2)




ALARM SILENCE
ALARM RESET
SIGH
MANUAL BREATH
SELECT
INSPIRATION HOLD
MODE SW
SW2
SW3
SW5
SW4
SW7
SW25
DOME_SW
ASSIST
SIMV
SW1
TAPER
4_POS ROTARY
J3
C5 10UF 35V TANT
+VPOT
BATTERY LED
/READY
VENT_INOP
TO MAIN P.C. BOARD
TIDAL VOLUME
FLOW RATE
BREATH RATE
PEEP/CPAP
SENSITIVITY
PRESSURE SUPPORT
HIGH PEAK PRESSURE ALARM
LOW PEAK PRESSURE ALARM
LOW PEEP/CPAP ALARM
LOW MINUTE VOLUME ALARM
HIGH BREATH RATE ALARM
APNEA INTERVAL
BACKUP BREATH RATE ALARM
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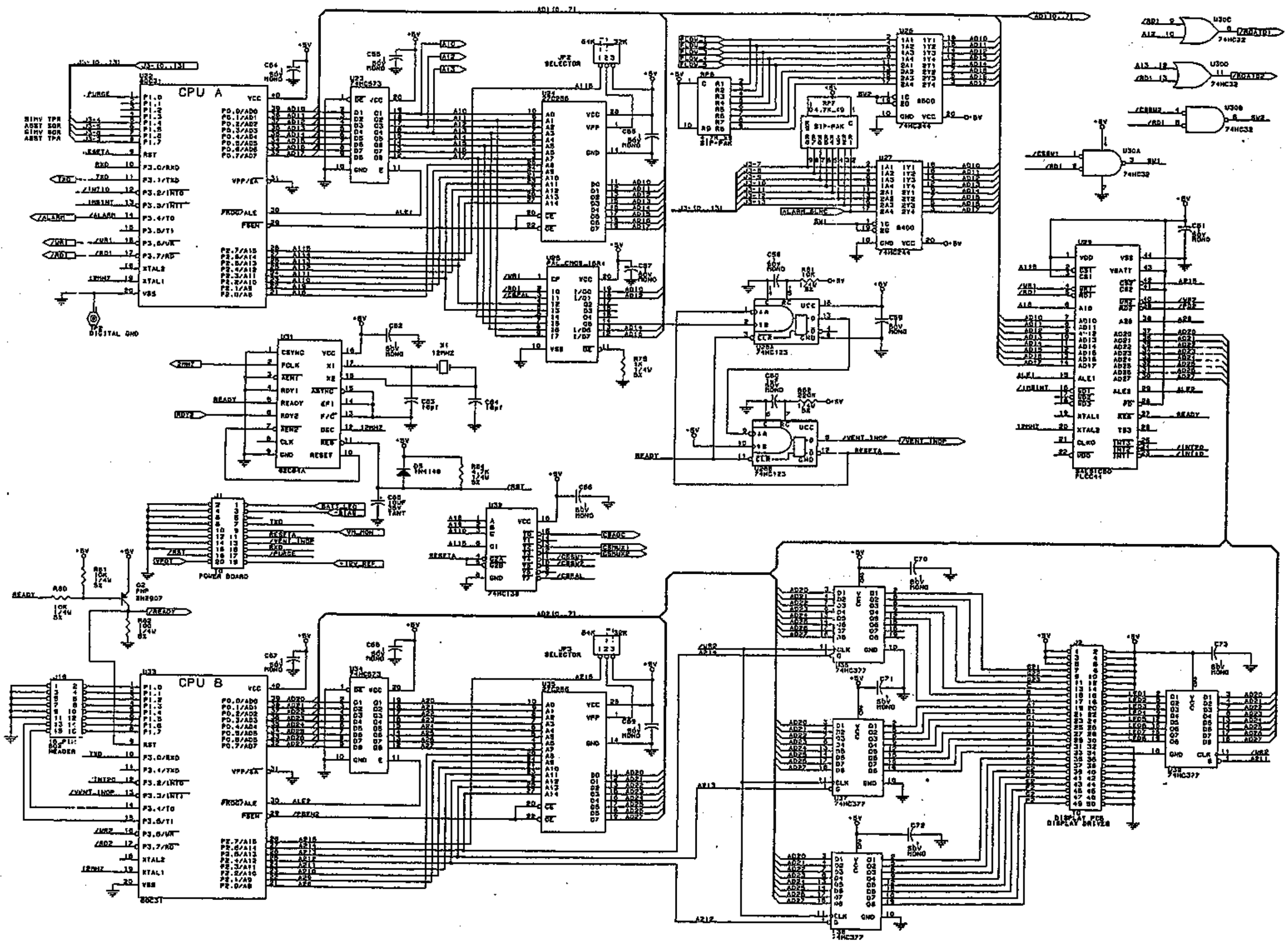
R40 10K TRIMPOT
ADJUST FOR 650 OHMS

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